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CONTENTS

Principles of Curriculum Making: PROFESSOR E. P. LYON 661

Industrial Fellowships of the Mellon Institute: THE LATE PROFESSOR ROBERT KENNEDY DUNCAN 672

The New Peruvian Expedition under the Auspices of Yale University and the National Geographic Society: PROFESSOR HIRAM BINGHAM 679

The Committee of One Hundred on Scientific Research of the American Association for the Advancement of Science 680

Scientific Notes and News 682

University and Educational News 686

Discussion and Correspondence:—

Multiple Factors in Heredity: PROFESSOR W. E. CASTLE. *Javel Water—a Simplified and Corrected Spelling:* J. F. SNELL. 695

Scientific Books:—

Johannsen's Manual of Petrographic Methods: PROFESSOR JOHN E. WOLFF. *Catalogue of Lepidoptera phalænæ:* DR. HARRISON G. DYAR. *Goldschmidt on Vererbungswissenschaft:* PROFESSOR A. FRANKLIN SHULL. *Hyde on Solvents, Oils, Gums, Waxes and Allied Substances:* PROFESSOR A. H. GILL. 690

Special Articles:—

Adaptation of the Tamarisk for Dry Lands: MARK ALFRED CARLETON 692

Financial Statement of the Permanent Secretary of the American Association for the Advancement of Science 694

Societies and Academies:—

The Botanical Society of Washington: P. L. RICKER. *The St. Louis Academy of Science:* PROFESSOR G. O. JAMES 686

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PRINCIPLES OF CURRICULUM MAKING[1]

THE favorite indoor sport of medical educators is curriculum making. As a game it ranks with jig-sawed pictures and "pigs in clover." It is not yet entirely clear whether this game should be played according to Hoyle or Marquis of Queensbury rules. The scores are published in our annual bulletins. Unfortunately no clear method of recording results has been devised. It is therefore hard to make comparisons, and no national champion has ever been declared. An expert can usually figure out the championship for any particular school. But the results would be much clearer if printed in some such form as this:

Professor Smith, Champion.... 964 hours.
Professor Jones, Runner-up... 807 hours.
Professor Brown, Booby prize. 24 hours.

It is evident that this game has interesting possibilities. Its serious discussion on this occasion may not be without value. Several of the schools of this Association have recently revised their curricula. Others are engaged just now in this work. These efforts are made necessary by a variety of conditions. In general it may be stated that dissatisfaction with the educational results obtained with existing courses of study is the principal cause of the desire for change. Furthermore, the new conditions brought about by increased entrance requirements make a readjustment of teaching desirable and perhaps imperative.

We Americans approach such a problem

[1] Presidential address at the meeting of the Association of American Medical Colleges, February 25, 1914.

with characteristic thoroughness. We are constitution makers by right of heredity. Our mechanical genius asserts itself. Our instinct is for standardization. We cut all our cogs to the same bevel. A rigid alignment of moving parts is insisted on. We are fond of link-belt machinery. We take advantage of gravity for feeding and screening. The machine runs well. The only trouble is that we forget the insignificant detail that we are making men instead of grinding corn.

A curriculum, gentlemen of the Association, is an important matter. Not so important as good individual teaching, it is true. Not so important, perhaps, as proper material equipment. Not so important as high ideals and a cooperative spirit among teachers. Nevertheless, curriculum making is a serious business. Are there no principles which may guide us in such an undertaking?

FORMER METHODS

The simplest way to form a curriculum is to have each professor state how much time he wants. This is doubtless the way the curriculum was made which every one was laughing at a few years ago and which required 230 hours of electro-therapeutics. The principle involved was "All cards have the same value. Every hand is a winner."

This method reaches its limit when the added demands of all the instructors make a larger sum of hours than the students can endure. As soon as this happened the usual procedure in the past was to place an arbitrary limit on total time requirements. Then each professor began to fight for as large a share of this time as he was able to obtain. This was probably the way in which a certain curriculum was produced containing 1,300 hours of anatomy. The principle was "Jack-high and a pistol take the pot."

These simple methods and elemental principles may have been adequate in ruder, simpler conditions. The best time-getter was often the best teacher. At least he was a strong personality. No standards existed. No state boards had formulated embarrassing exactions. The student considered one school as good as another; or, most likely, he believed the particular school he was attending to be the only good school. He was concerned with a certain square of parchment to be obtained after so many years and for the payment of so many dollars. He was not expected to think and succeeded in meeting all expectations.

THE FREE ELECTIVE SYSTEM

The opposite of these primitive methods of curriculum-making is the free elective plan. This has never been tried out in medical education. But Harvard College had a long experience with a program in which very little restriction was placed upon the students' choice of teachers and subjects. Many western universities gave equal or greater liberty to their students. It could almost be said that there was no curriculum. The principle was "American plan hotel. Everything on the table. You pay your money, and you take your choice."

The results were excellent for serious students of good judgment. But many men are not serious, and not all serious men have good judgment. A goodly proportion of men were found to be selecting their courses so as to fit in well with midnight suppers and late breakfasts and afternoon teas, or with more questionable employments. The snap course was the college man's blessing. Men were graduated whose education was an imitation veneer on a pasteboard background. As a

consequence all the colleges, I believe, have had to limit the freedom of election in a marked degree. The group system by which the student is compelled to do a considerable part of his work in one department or group of allied departments has been widely adopted. The principle is "A thorough training in a definite direction."

Of course the curriculum of a professional school is a group curriculum by the nature of things. The question is whether it shall be fixed and inflexible or variable and elastic.

GENERAL PURPOSES

Now it is evident that if we are to make any serious effort to find guidance in our own experiments in curriculum-building, we should begin by determining as well as possible what we are trying to do. It is easy to say that our first business is to make doctors—to make good doctors. But a "good doctor" is hard to know and harder still to define. I have discussed this matter before[2] and will only recapitulate my conclusions here.

A good doctor is a keen observer. We must train the powers of observation in our students. We may say that there is a technique of observing, and that we must teach this technique.

A good doctor is a trained experimenter. That is, he combines control of conditions with observation. We must train our students in experimental methods in the laboratory and at the bedside. This is technical training.

A good doctor is a skilled technician also in another and narrower sense of the word. He knows how to do certain things connected with the practise of his profession, things requiring accuracy of hand, ear and eye. He has attained a skilful adjustment of certain senso-motor reactions not provided by nor required in the ordinary experiences of life, but essential in medical practise. Such adjustment is attained only by repetition under direction; that is, by development of habit. We must train our students in the technique of their profession.

A good doctor is a man of judgment. He must be able to draw correct conclusions from observations and experiments. He must be able to synthetize isolated elemental facts into a unified compound. We express this idea when we say he must be able to think. And here is the greatest stumbling block. No one has discovered a royal road to thought. It almost seems as if it is in a man or it isn't. And yet thinking is really a kind of technique. It consists in making valuable associations. If you have on hand the proper thought-stuff and can make the right combinations of it —why, you think. Given a particular sensory stimulus, the resulting impulses presumably go bounding from part to part of the cerebral cortex instead of coming out immediately to the muscles. How these impulses travel depends on how the cerebrum is constructed and which paths have been made easy. Thought in this sense is involuntary response; it is reflex, it is habit.

A large part of our teaching is devoted to giving students what we consider valuable thought-stuff—facts, we call it. We also give them numerous examples of thinking—ready-made combinations of facts, or so-called conclusions. This is well. It ought to help them in the same way that seeing a blacksmith forge out a tool should help one to make that tool, or in the same way that seeing a surgical operation should help the student to do it. But when it comes to making new thoughts, the only

[2] *American Medical Association Bulletin*, January 15, 1911; also "Medical Research and Education," Science Press (1913), p. 375.

way is by practise and repetition and habit. We can help another man's thinking chiefly in the same way that we can help his drawing or his chemical analysis or his physical examination, by stimulating his interest, by showing him where he fails and by teaching him to criticize his own work, as he would any other technical achievement.

Finally, the good doctor is a man of character, which means again, I suspect, only that he has on hand certain kinds of brain-stuff, makes certain kinds of associations of it and reacts in certain ways to these associations. Here again example and criticism are the basis of teaching. A good doctor is skilled in the technique of right behavior. He makes mistakes in ethics no more than in counting blood corpuscles.

You will all see that I have used the word "technique" in a broad way. Probably I have stretched it too far. But for to-day we will let it stand and will ask ourselves what principles should guide us in attempting to make this kind of technicians out of the young men who come to us as students.

Putting the matter in another way, our purpose is to train scientific physicians. By a scientific physician I mean one who is imbued with the principles of science and trained in particular scientific methods. I do not mean that he should necessarily be an original investigator. I do mean that he should approach his work in the spirit of an investigator.

Our commonest stumbling block in considering a problem in curriculum making or in teaching is the unfortunate belief that we must turn out our graduates as fully trained doctors. "There is so much that they need to know," we say. This idea leads us to overcrowd the curriculum and deprive it of elasticity and virility. Our aim should be not to turn out a finished doctor, but a man who will continue to work and learn as long as he lives—a man who will consider that his student life has just begun on the day when he takes his diploma. Our aim should be not to produce a walking encyclopedia, but to inculcate the scientific spirit. What principles are likely to be of service in this work?

ENTRANCE REQUIREMENTS

Of course the first principle is that we start with good material. We depend upon certain "entrance requirements" to supply this material. We can not stop to consider these requirements to-day, except to remark their mechanical character. A sieve is a good instrument for separating different sizes of coal. It is a bad instrument for separating pebbles from diamonds. The best formulated entrance requirements will supply good material only when supplemented by personal consideration of the individual case. Often you can only tell the diamond by seeing whether it will scratch glass. My sentiment is that it is better to try out ten pebbles which will fail rather than risk throwing one diamond into the dump.

PRINCIPLE OF INDIVIDUAL DIFFERENCES

Having selected our students, we must recognize the inequality among them. No two freshmen are alike. No two seniors are alike. No two graduates are alike. No two old doctors are alike. We are all "born short" in one place, "born long" in another, to use William Hawley Smith's[3]

[3] "All the Children of All the People," Macmillan, 1912. Mr. Smith discusses also the similarities of children. Of course the principle of similarities is basic in any system of education. The trouble in medical education is that we have assumed not only similarity but even *equality* among students. This address is a protest against the prevailing rigid curricula and emphasizes therefore the differences of students, to the present disregard of their similarities. The latter

expressive metaphor. The recognition of the principle of inequality is a most important step in curriculum making. Everything else really rests upon it. If we had a magic yard-stick by which to measure each man's powers and lay out the curriculum adapted to develop those powers, it would be our duty to do so. Education would then become truly individualistic. Since we can not accomplish this ideal, we must do our best to approach it. We know that no body of men is able to lay out a perfect curriculum for medical students taken in the average or *en masse;* witness the severe criticism which may be laid against the A. M. A. model, founded though it was on two years' work by a committee of a hundred medical educators. Recognizing the principle of inequality of men, how much less can any faculty work out a fixed curriculum adapted to the student considered as an individual. To my mind the argument leads inevitably to the elastic curriculum. An elastic curriculum is not an elective curriculum, although the elective principle should find recognition in it.

PRINCIPLE OF RELATIVE VALUES

We have said that our aim is to develop technicians and that for this we must furnish facts on which the thing to be done, whether of hand or brain, is founded. In furnishing these facts, the important principle of relative values must receive emphasis. It is a fact that the stomach secretes a certain per cent. of hydrochloric acid. It is a fact that the lachrymal glands secrete a certain per cent. of sodium chloride. The former fact is much more valuable to a physician than the latter. It is valuable practically. Many other facts not immediately valuable in treating patients are valuable practically as thought-stuff. Facts are like medicines; some are for external and some for internal use. But the differences among facts as regards usefulness are as great as the differences among medicines. We should do our best from the multiplicity of facts to supply those most likely to be valuable to our students. Now the pie-maker is not a good judge of the value of pie as an article of diet, nor is the specialist in all respects in the best position to evaluate relatively his line of facts. The physiologist should have the help of the internist, the aurist, the oculist and the neurologist in determining what facts of physiology should be taught and the time to be devoted to this teaching. The principle applies equally to all the other teachers and their branches of knowledge.

PRINCIPLE OF MINIMUM REQUIREMENT

This leads to the principle of minimum requirement. Take anatomy, for example. We will all admit that certain facts of structure of the body form an indispensable part of a medical man's equipment. A knowledge of these facts must be demanded from every student. This minimum is hard to set—impossible, indeed, in a strict sense. Still, for practical purposes it must be set. In my judgment the minimum in nearly every subject is much less than schools have ordinarily required. They have required as much as possible, not as little as possible. In my opinion an effort should be made in each department to ascertain the minimum. This should be taught intensively. The merely desirable,

principle will take care of itself in any group curriculum, for as Professor Jackson has said: "Our medical students represent a selected group whose physical and mental characters are, broadly speaking, quite similar. This is tacitly assumed in making fixed requirements for the greater part of the curriculum. Yet the individual differences are undoubtedly of tremendous importance, and have hitherto been largely overlooked in medical education."

the questionable and the specialistic material should go into elective courses.

In formulating its minimum a department should bear in mind that not all the teaching of its subject-matter is done by itself. Anatomy is taught—should be and must be taught—by surgery and pathology; physiology, by medicine and pharmacology, and so on.

The sum total of these minima should constitute the required part of the curriculum. Probably they should make up between three fourths and seven eighths of the total. Nobody really knows.

PRINCIPLE OF SEQUENCE

In arranging a curriculum the principle of sequence must be kept in mind. Certain subjects are indispensable prerequisites to another subject. Others are desirable prerequisites. While this is true, it is also undoubted that this principle may be carried too far. The subject-matter of medicine is inextricably woven together. It is not even separable from the great body of general science. Our departments are in a measure artificial and arbitrary divisions. If a man goes into physiology before he has had anatomy, he is handicapped, it is true. But, on the other hand, when he gets to anatomy after physiology, he will carry to that work usable facts and enlarged interest. We may acknowledge that systematic knowledge of disease is valuable before the student can take up clinical work to best advantage, and consequently we make didactic courses prerequisite to clinics. But consider for a moment how much more intelligently the student would approach a systematic lecture course if he had previously seen some sick people. We should not allow too rigid an application of sequence to interfere with larger aims of elasticity and the recognition of individual capability and needs.

PRINCIPLE OF CONCENTRATION

In making a curriculum the principle of concentration deserves consideration. The theory is that the student does better work if he confines himself to one or a few subjects for a given short period of time. He is to concentrate on one thing and get it done. The antagonistic view is that the student gathers more from a subject kept before him for a long time. Under this theory the curriculum may include from six to a dozen subjects running through a semester or a year. Recently I met a freshman in the college of science, literature and the arts of our university who was studying seven subjects. She complained of being harried and overworked. I believe she would do better with the same number of class hours devoted to only three or four subjects. I think we should avoid the multiplicity of subjects in the junior and senior years by concentrating one hour a week lecture courses so as to run a shorter time and more periods a week. On the other hand, I can not bring myself to accept the Harvard plan by which only anatomy is studied the first semester, only physiology the second, and so on. I think Harvard has stuck to this plan more for the benefit of the teachers, who thus escape class work half of each year, than for the benefit of the students. Be that as it may, too much concentration is bad pedagogy; and in as much as it contributes to a rigid curriculum, it is a bad principle of curriculum making. A proper medium is to be sought between concentration to the crystallization point and dilution to tastelessness. At the present time we are more guilty in the latter direction, particularly as regards the rapid shifting of students among clinical instructors. If Dr. A. meets a group of students to-day and does not see them again for six weeks, how is Dr. A. to make his personal-

ity felt in these students' training? Dr. A.'s influence is lost in homeopathic dilution, which we should be ashamed to countenance.

The proper degree of concentration needed to produce best results should be possible of determination by the methods of experimental psychology. I understand that something has been accomplished in this line, particularly as regards memory. It is a common impression that "cramming" does not conduce to permanent acquisition. This conclusion is supported by laboratory tests. On the other hand, experiments prove that a subject referred to only at long intervals is not well remembered. There must be a golden mean between concentration and dilution. For this golden mean we should earnestly strive, and the psychologists should help us to find it.

PRINCIPLE OF ATTENTION AND INTEREST

Taking up more particularly the individual student in curriculum making and teaching, we should take into account the element of interest. A girl can dance all night with the pleasurable expenditure of several foot-tons of energy (no pun intended). Her back aches if she sweeps the floor, though the muscular energy discharged be insignificant. We should avoid a multiplicity of detailed laboratory exercises illustrating the same thing. The humdrum of laboratory repetition kills interest and initiative. Recognition of the principle of interest means an elastic curriculum, for the interest of one student is not the same as the interest of another student.

Interest is the basis of attention and of that self-activity which Dr. Jackson[4] so well discussed before this association two years ago. So important is this element in education that almost any sacrifice is warranted which will attain it. In our sophomore schedule at Minnesota this semester there is provision for six hours of elective work. It has been our custom in the case of conditioned or backward students to compel them to carry the required courses and postpone their electives. The other day a student appeared before the conference committee of the faculty and made a strong plea to be permitted to carry his elective. He said he was interested in that work and would rather postpone one of his regular studies. The committee voted favorably on his request; and in my opinion they acted wisely, for his failure to work with serious effort heretofore has been due to lack of interest. I expect him soon to observe that this elective work in which he is now interested is really tied up with all the rest. I expect to see his interests broaden and all of his work improve.

PRINCIPLE OF RESPONSIBILITY

Closely related is the principle of student responsibility. We are interested in work for which we are responsible. This is especially true if we select the work ourselves. A fixed curriculum deprives the student of all responsibility. He becomes a boarder coming in to meals when the bell rings, not a man laboring for his daily bread. If he may choose his subject or his instructor, his interest and responsibility increase.

Workers in the field of animal psychology tell us that animals carried through a maze never learn how to find their way alone. Let us remember this when tempted to help students over difficulties. Our teaching and our courses of study must be so planned as to encourage initiative and responsibility.

[4] C. M. Jackson: "On the Improvement of Medical Teaching," SCIENCE, N. S., Vol. XXXV., p. 566 (1912). Also, "Medical Research and Education," Science Press (1913), p. 367.

PRINCIPLE OF RESEARCH

The principle of research is very important in curriculum building. I do not advocate research with the idea that we should announce a great discovery every few minutes. I advocate it as supplying the proper atmosphere for teaching. The fixed curriculum segregates a certain portion of knowledge and teaches it as law and gospel. The student is like a red corpuscle confined by the vessel walls to a definite circuit. If the teacher has research interests, he carries them alone. His students can not follow him. The elastic curriculum permits the capable student to put out an occasional pseudopod and make little excursions with his teacher into the unknown. This can not help but react upon both student and teacher; and most important of all, on the spirit of the school. If time and opportunity for research are to be offered even to the exceptional student, it means that the electives can not be confined to the last year, as at Harvard, nor to one semester, as in some other schools. The free time should be scattered through the course, at least beginning with the sophomore year. I sometimes hear that the sophomore does not know enough to select any of his work. I can not agree. The sophomore in most of our medical schools is a junior or senior in the college of arts. He is a university man. He should be responsible. He should be thinking about what he is doing. The nursing bottle should be taken away, and he should choose and masticate his own food. Not many will nibble at research, but the aroma of it may well permeate the whole pantry. It will improve the taste of all the other food.

PRINCIPLE OF SPECIALIZATION

The principle of specialization may be given some attention. While every medical student should have the fundamental training of a general practitioner and while most of the elective courses will naturally be adapted to strengthen the student's general grasp, there is no objection, in my opinion, to a moderate extension of specialistic instruction. There are very few students who would care to move far along a specialty in their undergraduate course, and the dean or students' work committee should have power to prevent an abuse of this principle by limiting election in the specialties when such election would be likely to prejudice a student's general training.

PRINCIPLE OF UNEQUAL PROGRESS

Finally, regard for the differences and inequalities among students should make us consider their inequality of progress: the principle of unequal velocity, if you will. Some students by physical constitution and mental make-up are calculated to go forward more rapidly than others, who, being built on the "slow and careful" plan, may in the end be just as good doctors. Our arrangement of students into definite classes and a four years' required attendance is the worst possible condition for the extra bright man, whom it tempts to laziness, and for the slow man, whom it pushes beyond his powers. In my opinion students should be received at any time when a workable program can be arranged for them, and graduated at the end of any semester or summer term when they may have completed the requirements. Our extra intern year at Minnesota, as part of the requirement for the degree and consequently of attendance, will, I think, allow us to work this plan without running counter to the four-year rule of the state laws. The class system is a pernicious artificiality in education and should be done away with in professional education, if not more widely. So should the four-months' required vaca-

tion. The doctor-in-practise works eleven months or more. Why should the doctor-in-making work only eight or nine? Some students may need the long vacation for health's sake; others may need it for financial reasons. But some would be better off without the long interruption of their studies. Moreover, important elements of economy argue for the continuous session and a curriculum adapted thereto. Our expensive equipments stand idle one third of the time. Our hospitals and dispensaries go on the year around and are unused for teaching for several months. This would be poor practise in any line of business. For our northern schools, at least, the University of Chicago idea with its four quarters and its liberal curriculum, appeals to me as eminently wise. The next best thing is a strong summer term for which credit[5] is given on the regular course.

Your professors may say that they can not teach the year around. Well and good. They ought not to. While some of the older men should be "on the job" during the summer and may arrange their vacations at some other season, on the whole the summer quarter or term is a good time to give the younger men a chance. Let them conduct courses given at other times by full professors. A repetition of courses, at least in certain subjects, has advantages and is essential if a really elastic curriculum is to be developed.

CURRICULUM MAKING FROM THE SIDE OF THE TEACHER

I have gradually swung this discussion over from the side of the student to that of the teacher. Several principles of curriculum making may be formulated from the side of the faculty.

[5] The distinction between subject credit and time credit is not sufficiently recognized by medical educators. It is only time credit which is restricted by the state medical laws.

THE DEVELOPMENT OF TEACHERS

One of these principles is the development of the teacher. The rigid curriculum works but little for this cause. A professor of principles of surgery, for example, lectures year after year on that subject. For years perhaps the same manuscript is read to the classes. There is no incentive for a younger man to prepare himself. Finally, the old professor drops away, and a new and untried man must take his place. An elastic curriculum with repetition of the course under various instructors means the opportunity for the development of new men all the time. The prepared man is ready for the advanced position.

PRINCIPLE OF COMPETITION

The principle of competition is as important for efficient teaching as for any other trade or business. The rigid curriculum tends to develop a trust in teaching, with the usual bad characteristics of trusts. The elective system by giving the student a choice among several men furnishes each teacher with incentives to bring his work to the highest state of efficiency. The experience of Rush Medical College in this regard has been very instructive.

It might be thought that students would abuse this privilege of electing their instructors and that the easiest teacher would be most popular. That has not been the case. The students can be trusted to go where they get what they consider the best for themselves. Their judgment, on the whole, can be trusted. A general rule requiring approval of electives by the dean or a committee is a sufficient safeguard against the few who might search for "snap" courses.

The elective system tends to make a larger number of men available and useful as instructors and a larger number of hospitals available and usable for clinical in-

struction. So long as every student must appear before every instructor we have the tendency either unduly to reduce the number of instructors or unduly to reduce the time the individual instructor teaches. Either horn of the dilemma is dangerous. To be effective, clinical teaching must approach the ideal of individual teaching. Not how many students an instructor teaches, but how well he instructs a limited number, should be the criterion of his usefulness to a school and of his own sense of satisfaction with his work. As I have said earlier, nothing is worse than a whirlwind program which sends the students in vortices of section instruction so rapidly from teacher to teacher that no one can impress his personality upon the students. The belief that every teacher must teach every student, long since given up in colleges of arts and sciences, is pernicious and inexcusable. If your ideal of teaching is merely to reach as large a number of prospective consultants as possible, stop teaching and buy stock in a patent medicine company.

THE CURRICULUM AND THE DEPARTMENTS

As regards whole departments of instruction as distinguished from individual instructors, certain principles of curriculum making may be mentioned. A proper regard for the "born long" and "born short" demands greater elasticity in departmental procedure than is usually the case in our American schools. There should be better provision for the irregular student. Opportunities for laboratory work should be afforded at other than scheduled hours. Men should be encouraged to work alone or with a minimum of supervision. Let us limber up our laboratory organizations. Let our motto be salvation by individual work rather than salvation by formal creed. "Laboratory" should be synonymous with "Opportunity" not with "Drudgery."

The offering of electives is one important means of liberalizing a department. This system allows the instructor to vary at least a part of his work from year to year. It enables him to teach to the interested few those subjects in which he is immediately interested. It diminishes the temptation to introduce the instructor's fads as part of his required courses. It broadens the interests of a department by giving scope for all its members.

The elective system allows the young instructor who is assisting in a large required course to gain independence and confidence by conducting a small elective course in his special line. This is important.

THE CURRICULUM AND THE SCHOOL AS A WHOLE

Now as regards the school as a whole, certain principles of curriculum making may be formulated. It goes without saying that conditions as regards the quality of instructors, students and material facilities must vary among institutions. They ought not to adopt identical curricula.[6] The American Medical Association and Association of American Medical Colleges have presented models which are very valuable as points of departure. A curriculum committee should consult other schools, but not with the purpose of adopting their curricula unchanged. Each school should work out its curriculum with broad wisdom to suit its own conditions. It would be worse than folly, for example, if small and weak schools should attempt a wholesale adoption of the elective work which I so strongly

[6] While this statement is true, it may also be stated that important advantages would follow a substantial agreement among the schools as to the minimum requirements in each branch. For one thing, migration of students, at present very difficult, would be facilitated.

advocate. It would be folly even for a strong school to push this principle equally in all departments. A curriculum is a road or a race track. Road materials are quite different in central Illinois from those which abound in New England. Bear this crude analogy in mind.

The school revising its curriculum should avoid all possibility of allowing this important function to deteriorate into a contest for teaching time. Such a procedure loses sight of the principles involved and the objects to be sought. Consequently, curriculum revision must be approached with care and carried forward with tact and open-mindedness. Our recent experience at Minnesota is perhaps illuminating. The committee on revision was composed of three men only. These men studied conditions thoroughly and were able to speak with authority concerning conditions in our school and elsewhere. They studied the educational and pedagogical problems involved. This committee did not overwhelm the faculty by bringing in a complete report at one time. It first secured the approval of the faculty for certain general principles such as (*a*) "The necessity of limiting the scheduled work to about thirty hours a week or about 4,000 hours for the course." (*b*) "The necessity of clinic clerkships as a required part of the senior schedule." (*c*) "The desirability of elasticity to meet individual preparation, abilities and needs of students." The individual members of the faculty, recognizing the validity of these educational policies, approached the proposal to decrease their hours in excellent spirit. Consultations of departments with the curriculum committee led to practical unanimity of opinion on details; and when the final report was presented to the faculty, approval was quickly secured.

Gentlemen of the association, you have listened well. Probably you got into the habit when you sat upon the benches as medical students. Probably, like the students of this day, of whom we are dealing, you learned to "let it go in at one ear and out at the other." Is our lamentable ability to hear and forget due to something like interference of sound, some mental process by which the impressions from one ear annihilate those from the other? Or is it rather true that we are only to be jarred from our complacent forgetfulness, our nonchalant do-nothingness, by something unusual? I think the latter, at any rate, is a fact; and I am going to risk the dignity of the presidency and hang the moral of my previous remarks on some lines copied from the back of a seat in the amphitheater of one of our medical schools, where they had been scratched in the varnish by some medical student, departed and forgotten:

> Talk, Talk, Talk,
> Till my ears are split by the din.
> Sit, Sit, Sit,
> Till my pelvis sticks through the skin.
> In clinic and lecture and quiz
> I wear out my pants to the seam,
> Till over the benches I fall asleep
> And wear 'em out in my dream.

You laugh! But really are not these doggerel verses as pregnant with pity as the "Song of the Shirt"? Are they not as full of meaning for us as were the words of Hood for callous wealth and heedless government in poverty-stricken London?

The plaint of the student we have heard before, delivered in more dignified but less expressive form by speakers on this floor. Our students are overcrowded. They have no time to think. They do not think. Their individual qualities are crushed. They are made to conform to a common mould. The curriculum is largely responsible. We are responsible for the curriculum.

We make the usual specious arguments. The students are poorly prepared. The time of the course is too short. There is so

much to teach. Medicine is going forward so fast.

Let us broaden our conception of medical education by broadening our conception of education itself. Education is primarily the bringing out of something from within, not the forcing of something in from without. It is the discovery of the individual to himself. It is a process of training, not a process of fattening.

If these conceptions of education gain possession of us, we shall approach our teaching and our curriculum making in a corresponding spirit, and some at least of the difficulties and disappointments of our labor will disappear.

E. P. Lyon

Medical School of the
University of Minnesota

INDUSTRIAL FELLOWSHIPS OF THE MELLON INSTITUTE[1]

Since January, 1912, I have made no report to this journal on the progress in the system of industrial fellowships initiated by me at the University of Kansas and since transferred to the University of Pittsburgh.

The working of these fellowships began September 1, 1911, on the university campus at Pittsburgh and in the temporary building erected at a cost of about $10,000. In March, 1913, Mr. Andrew William Mellon and Mr. Richard Beatty Mellon, brothers and citizens of Pittsburgh, impressed by the evident practical value of this system both to learning and to industry, established it on a permanent basis through the gift of over half a millon dollars and consented to allow their family name to be placed upon it as the "Mellon Institute of Industrial Research and School of Specific Industries of the University of Pittsburgh." While working in affiliation with the university and in close sympathetic accord with it, the institute is possessed of its own funds and is under its own management.

[1] This article was written by Dr. Duncan shortly before his death.

The gift of the Messrs. Mellon has been divided for expenditure as follows:

FOR IMMEDIATE EXPENDITURE:

Permanent building	$250,000
Apparatus	60,000
Library	20,000

FOR YEARLY MAINTENANCE FOR FIVE YEARS:

$40,000 per year.

Since September, 1911, the following Fellowships have been established and in operation:

1. BAKING:*[2]

$750 a year for 2 years.
Bonus, maximum cash: $2,000.

Fellow:

Wilber A. Hobbs, B.S. (University of Kansas). (Accepted November 30, 1910.)

2. ABATEMENT OF SMOKE NUISANCE:

$12,000 1st year; $15,000 2d year; $12,000 3d year.

Fellows:

Staff in Charge

R. C. Benner, Ph.D. (University of Wisconsin), chief fellow first and second years.

J. J. O'Connor, Jr., A.B. (University of Pittsburgh), economist and chief fellow third year.

W. W. Strong, Ph.D. (Johns Hopkins), physicist.

A. F. Nesbit, B.S. (Massachusetts Institute of Technology), electrical engineer.

J. A. Beck, LL.B. (University of Pittsburgh), attorney.

E. H. McClelland, Ph.B. (Lafayette), bibliographer.

O. R. McBride, B.S. (Purdue University), engineer.

J. E. W. Wallin, Ph.D. (Yale University), psychologist.

H. H. Kimball, Ph.D. (George Washington University), meteorologist.

A. B. Bellows, B.S. (Massachusetts Institute of Technology), engineer.

J. F. Clevenger, M.S. (Ohio State University), botanist.

C. H. Marcy, bacteriologist.

Advisory Staff

Oskar Klotz, M.D., C.M. (McGill University), senior fellow.

[2] * means that the fellowship has expired.

E. W. Day, A.M., M.D. (Georgetown).
W. C. White, M.D. (Toronto).
R. T. Miller, Jr., M.D. (Johns Hopkins).
W. W. Blair, M.D. (Hahnemann).
B. A. Cohoe, A.B., M.D. (Toronto).
S. R. Haythorn, M.D. (Michigan).
W. L. Holman, M.D. (McGill).
E. B. Lee, architect, senior fellow.
Richard Hooker, B.S., architect.
C. T. Ingham, architect.
Richard Kiehnel, architect.
Carlton Strong, architect.
K. K. Stevens, B.S., architect.
(November 30, 1910; revised June 24, 1911.)

3. ON THE RELATION OF THE POTS TO GLASS IN GLASS-MAKING AND THE ELIMINATION OF "STREA":*

$1,500 a year for 2 years.
Bonus: $2,500.

Fellow:
Samuel R. Scholes, Ph.D. (Yale University).
(January 25, 1911.)

4. BAKING:*

(Wholly independent of but with acquiescence of No. 1.)

$4,750 a year for 2 years.
Bonus, cash: $10,000.

Fellows:
Henry A. Kohman, Ph.D. (University of Kansas), senior fellow.
Charles Hoffman, Ph.D. (Yale University).
Alfred E. Blake, A.B. (New Hampshire College).
(January 25, 1911.)

5. GLUE:

$1,200 a year for 2 years.

Fellow:
Ralph C. Shuey, B.S. (University of Kansas).
(February 3, 1911.)

6. SOAP:

$1,200 a year for 2 years.

Fellow:
Paul R. Parmelee, B.S. (University of Kansas).
(February 3, 1911.)

7. UTILIZATION OF FRUIT WASTE:*

$1,000 a year for 2 years.
Bonus: $10,000.

Fellow:
F. Alexander McDermott (George Washington University).
(May 12, 1911.)

8. COMPOSITION FLOORING:*

$1,500 a year for 2 years.
Bonus: 1 per cent. of sales for 5 years.

Fellow:
R. Rex Shively, B.S. (Oklahoma A. and M. College).
(August 15, 1911.)

9. CRUDE PETROLEUM:

$10,000 first year; $10,000 second year; $10,000 third year, including apparatus fund.
Bonus: Collective interest 10 per cent.

Fellows:
Benjamin T. Brooks, Ph.D. (University of Göttingen), senior fellow.
Clinton W. Clark, M.A. (Ohio State University).
Lester Pratt, M.S. (New Hampshire College).
Hugh Clark, M.A. (Ohio State University).
Arthur H. Myer, A.M. (Leland Stanford Jr. University).
Frederick Padgett, B.S. (University of Pittsburgh).
F. W. Bushong, Sc.D. (Emporia College).
I. W. Humphrey, B.S. (University of Kansas).
George W. Stratton, Ph.D. (Ohio State University).
(September 22, 1911.)

10. NATURAL GAS:

$4,000 first year; $4,000 second year; $6,000 third year, including apparatus fund.
Bonus: 5 per cent. industrial results.

Fellows:
R. H. Brownlee, Ph.D. (University of Chicago), senior fellow.
Roy H. Uhlinger, M.A. (University of Pittsburgh).
(September 22, 1911.)

11. CEMENT:*

$1,800 a year for 2 years.
Bonus: $10,000.

Fellow:
J. F. MacKey, Ph.D. (University of Toronto).
(September 22, 1911.)

12. FOODS, PROBLEMS RELATED TO THE MANUFACTURE OF:

$5,000 a year for 2 years.
Bonus: $10,000.

Fellows:
Clarence C. Vogt, Ph.D. (Ohio State University), senior fellow.
Harry P. Corliss, Ph.D. (University of Pittsburgh).
Mrs. Lou H. M. Vogt, Ph.D. (Ohio State University).
(May 20, 1912.)

13. FATS AND OILS, BLEACHING OF:

$1,500 a year for 2 years + $300 apparatus fund.
Fellow:
Leonard M. Liddle, Ph.D. (Yale University).
(May 22, 1912.)

14. EFFECT OF HIGH POTENTIAL ELECTRICITY ON CHEMICAL REACTION:

$1,000 a year for 2 years + $300 apparatus fund.
Additional consideration.
Fellow:
W. E. Vawter, B.S. (University of Kansas).
(October 28, 1912.)

15. DISCOVERY OF METHODS OF COATING STEEL OR OTHER METALS WITH COPPER OR OTHER METALS:

$1,500 a year for 1 year + $500 apparatus fund; 3 months' extension.
Bonus: $10,000.
Fellow:
C. L. Perkins, B.S. (New Hampshire College).
(December 4, 1912.)

16. EXTRACTION OF COPPER FROM ITS ORES AND FROM COPPER "TAILINGS":*

$1,500 a year for 1 year.
Teaching Fellow:
Howard D. Clayton, B.A. (Ohio State University).
(December 1, 1912.)

17. DESERT PLANT AND ADDITIONAL PROBLEM:

$1,500 a year for 1 year + $300 apparatus fund.
Bonus: 7 per cent. interest industrial results.
Fellows:
R. R. Shively, Ph.D. (University of Pittsburgh).
Alfred E. Blake, M.S. (University of Pittsburgh).
(January 31, 1913.)

18. BAKING:

$6,000 a year for 2 years + $500 apparatus fund.
Bonus: $10,000.
Fellows:
Henry A. Kohman, Ph.D. (University of Kansas), senior fellow.
Charles Hoffman, Ph.D. (Yale University).
Trueman M. Godfrey, B.S. (University of Kansas).
(May 12, 1913.)

19. ALUMINUM:

$5,000 a year for 2 years, including apparatus fund.
Bonus: $10,000.
Fellows:
Hugh Clark, Ph.D. (University of Pittsburgh).
Lester A. Pratt, Ph.D. (University of Pittsburgh).
(May 12, 1913.)

20. GLUE:

$1,500 a year for 2 years + $300 apparatus fund.
Fellow:
Ralph C. Shuey, B.S. (University of Kansas).
(May 12, 1913.)

21. SOAP:

$1,500 a year for 2 years + $300 apparatus fund.
Fellow:
Ben H. Nicolet, Ph.D. (Yale University).
(May 12, 1913.)

22. GLASS:

$1,500 a year for 2 years + $300 apparatus fund.
Bonus: $3,500.
Fellow:
R. R. Shively, Ph.D. (University of Pittsburgh).
(July 14, 1913.)

23. RELATION OF ELECTRICAL POTENTIAL TO CATALYTIC ACTION:

$1,500 a year for 2 years + $300 apparatus fund.
Bonus: 5 per cent. industrial results.
Fellow:
Frank F. Rupert, Ph.D. (Massachusetts Institute of Technology).
(July 14, 1913.)

24. EXTRACTION OF COPPER FROM ITS ORES AND FROM COPPER "TAILINGS":

$1,500 a year for 1 year + $300 apparatus fund.
Fellow:
Charles O. Brown, M.A. (Cornell University).
(July 14, 1913.)

25. YEAST:

$5,200 a year for 2 years, including apparatus fund.
Bonus: $10,000.
Fellows:
F. Alex. McDermott, B.S. (University of Pittsburgh), senior fellow.
William Smith, Scholar (University of Pittsburgh).

Ruth Glasgow, M.S. (University of Illinois), bacteriologist.
James C. Cuthbert, Scholar (University of Pittsburgh).
(July 14, 1913.)

26. HARDENING OF FATS:

$1,000 a year for 1 year + $300 apparatus fund.
Bonus: 49 per cent. interest.

Fellow:
E. O. Rhodes, B.S. (University of Kansas).
(September 19, 1913.)

27. LEATHER SCRAP:

$1,000 a year for 1 year + $200 apparatus fund.
Bonus: 10 per cent. interest.

Fellow:
R. Phillips Rose, M.S. (University of Ohio).
(October 22, 1913.)

28. FERTILIZER:

$2,500 a year for 2 years, including apparatus fund.
Bonus: $5,000.

Fellow:
Earl S. Bishop, D.Sc. (Queen's University, Ontario, Canada).
(November 1, 1913.)

29. COPPER:

$6,000 a year for 1 year, including apparatus fund.
Fellows:
F. R. Weidlein, A.M. (University of Kansas), senior.
H. D. Clayton, B.S. (Ohio State University).
G. A. Bragg, B.S. (University of Kansas).
(November 6, 1913.)

30. RADIATORS:

$2,000 a year for 2 years, including apparatus fund.
Bonus: $5,000.

Fellow:
J. C. Ballantyne, B.Sc. (University College, London).
(November 18, 1913.)

31. TURBINE ENGINES:

$1,800 a year for 1 year, including apparatus fund.
Bonus: $3,000.

Fellow: (not yet appointed).
(January 5, 1914.)

32. GLASS:

$1,800 a year for 1 year, including apparatus fund.
Bonus: 25 per cent. interest.

Fellow: (not yet appointed).
(January 5, 1914.)

The total amount of money so far handed in by industrialists for expenditure in the little building mentioned above is $183,800. The total fellowship list now runs at the rate of $97,400 per year.

About the results of these fellowships, this much at this time may be stated:

1. Received a bonus of $1,000.

2. On the basis of the experimental and investigative work accomplished has been extended through a third year.

3. On the termination of this fellowship the holder went over to the company at a salary of $2,500 per year.

4. The bonus of $10,000 has been acknowledged by the company and the first installment paid. The company then asked for a second fellowship at an increased rate and with a second bonus of $10,000, which appears in this list as No. 18.

5. In recognition of the work of this fellowship the company on its expiration established a second fellowship at an increased rate, which appears in this list as No. 20.

6. On the termination of this fellowship, the fellow went over personally into his company with his process and in recognition of its success the company then established a second fellowship on the same subject at an increased rate, which appears in this list as No. 21.

7. On the conclusion of this fellowship, in lieu of the bonus, under certain conditions the proprietary rights in his process were conferred upon the fellow.

8. While this fellowship was successful, from the standpoint of the results of the investigation, it was a failure owing to changing circumstances in the specific example of the industry concerned.

9. This large and important fellowship, which had a tenure of two years, has been extended through a third year on the basis of the results accomplished. These results are of prime importance to the petroleum industry.

10. This fellowship, established for two years at $4,000 a year, has been extended through a third year for the sum of $6,000, the salary stipend of the senior fellow being raised from $2,500 a year to $4,000 a year.

11. This fellowship was a failure, owing in large measure to a lack of willingness on the part of the company concerned to cooperate with the administration and the fellow.

12. This fellowship is now in operation and it is believed that it will have a successful termination.

13. There is no question about the very success-

ful operation of this fellowship and of its ultimate results.

14. This fellowship has already yielded the essentials of an important industrial process. It has a very large importance to the institute, owing to the fact that the donor has made over all results to the institute to be used for the establishment of further researches by the institute.

15. The laboratory investigation of this subject has been completed and its large-scale working is now being arranged for. Pending the completion of the large-scale operation, the fellowship has been extended.

16. This investigation has proved so important that it has been extended through the addition of another fellowship, No. 24, at $1,500 a year, and, subsequently, of still another, No. 29, at $6,000 a year.

17. The original object of this fellowship proved impossible of an industrial solution, owing to the fact that investigation of the plant concerned showed that it contained nothing of potential industrial value. The object of the investigation was thereupon changed and the ultimate results are not yet determinable.

18. Was established by the same company on the basis of the success of No. 4. While it has been in operation only since September, it already unquestionably deserves its bonus.

19. A fellowship yielding results of prime importance.

20. Was established on the basis of the success of No. 5.

21. Was established on the basis of the success of No. 6.

22. Is already unquestionably successful.

23. A most interesting fellowship on a most interesting subject. This research is remarkable in that the donor desires that the institute should receive for its own purposes 70 per cent. of the results.

24. Established in correlation with No. 16. It is already yielding promising results.

25. A strong fellowship in operation only since September.

26. This fellowship was transferred from the University of Kansas. It has already yielded an important industrial process.

27. It is impossible to forecast the end of this fellowship.

28. Begins operation on January 5, 1914.

29. Was established in cooperation with fellowships No. 24 and No. 16. The results of this fellowship would probably justify the total expenses of the whole fellowship system.

30. Went into operation a month ago.

31. Has been accepted but is not yet signed.

32. Has been accepted but is not yet signed.

In the spring of 1912 owing to ill health, the result of too much responsibility, arrangements were made to give me an associate director, Dr. Raymond F. Bacon, who came to me from the Bureau of Chemistry at Washington. Dr. Bacon's scientific prescience, his suggestive power in research, together with his sympathetic understanding of the traditions of the work and his personal loyalty have made him an ideal associate. Since the spring of 1913, he has been aided in his work of supervision through the appointment of Dr. E. Ward Tillotson as assistant director. Dr. Tillotson has already established the success of several fellowships through his personal supervision.

The administration of the institute consists at present of the director, with the associate director and assistant director. Their work of direction and supervision is greatly lightened by the senior fellows. It should be pointed out that the fellowships of the institute consist of two kinds, individual and multiple fellowships. An individual fellowship utilizes the services of one man, directly responsible to the administration; a multiple fellowship, the intensive services of several men under the direction of a senior fellow who in turn is directly responsible and under the administration. There are seven senior fellows in the institute. The adequate supervision of the thirty-nine fellows at present in the institute is in this way entirely practicable and explains the results obtained.

The $97,400 per year at present being expended by this institute in the various researches in operation have been handed in to the institute by various companies in accordance with a definite agreement between each company concerned and the institute.

As this whole system of research is locked up in or depends upon these agreements, their importance warrants my insertion at this point of an agreement which is deemed by us at this time as representative of a reasonable arrangement. The one I submit is that of a multiple fellowship in blank.

COMPANY'S MULTIPLE FELLOWSHIP AGREEMENT

(Fellowship No. XXIX.)

THIS AGREEMENT made and entered into this ——— day of ——— 1913, between the

Mellon Institute of the University of Pittsburgh, of the City of Pittsburgh, Pennsylvania, hereinafter called the "Institute" and the ————————, of ————, ———————— hereinafter called the "Company,"

WITNESSETH: that for the purpose of promoting the increase of useful knowledge, the parties hereto agree as follows:

1. The Company shall pay to the Institute annually in advance for a period of ——— years, beginning ————, 1913, the sum of ——— ——— dollars ( ) for the foundation of a Multiple Industrial Fellowship to be known as ————————————————, the exclusive purpose of which is ————————————————————————————————————

2. The Institute shall accept the sums so to be furnished by the Company and shall devote them to the furtherance of the problems of this Fellowship; and to this end all money received from the Company under this Agreement shall be paid over by the Institute in monthly installments to the holders of this Fellowship in such amounts as may be agreed upon by the Institute and the Fellows concerned, or expended for such apparatus and supplies related to this research as the Director of the Institute may deem it advisable to purchase and for traveling expenses related to the elucidation of the problems concerned. The Fellows shall be provided, at the expense of the Institute, with a separate laboratory and with such apparatus, supplies and reagents as in the opinion of the Director constitute a reasonable provision. The Company, on its part, shall cooperate with the Institute in this research by providing the Director thereof and the Fellows of this Fellowship with its sympathy and with whatever knowledge of the subjects of research it may possess, and, on approval of the Company, with its factory facilities for large-scale experimentation.

3. The holders of the Fellowships provided hereunder shall be appointed by the Committee of Management of the Institute upon the nomination of the Director in accordance with the terms of their formal letters of application to and as approved by the Director, and they shall give their whole time and attention to the object of the Fellowship, with the exception, if the Director so elect, of three hours a week which each shall give to instructional work in the University of Pittsburgh. The Fellows shall work under the advice and direction of the Director and shall from time to time through the Director forward to the Company reports of the progress of their work. During the existence of the Fellowships provided hereunder the Company shall have the right, through and with the acquiescence of the Director, to employ and take into its regular service any or all of the Fellows of this Fellowship, upon terms to be agreed upon between the Fellow or Fellows and the Company, and the Institute shall appoint a successor to the Fellowship vacated by reason of the regular employment of one or more of the Fellows by the Company, provided the condition of the research work shall in the opinion of the Director make necessary or advisable the appointment of such successor.

4. The Institute, at the expiration of the Fellowship, shall return to the Company any money paid to it by the Fellow, in case any thereof shall remain unexpended for the purpose of this Fellowship.

5. Any and all discoveries made by the Fellows, or any of them, during the term of this Fellowship as well as all information obtained by them germane to the subjects of their investigation shall become the property of the Company, subject to the terms and provisions of this Agreement, and any Fellow making such discovery or obtaining such information shall promptly and without demand make revelations of all such information and discoveries. Such revelations shall be made to the duly designated representatives of the Company directly, or through the Director, as the Director may determine.

6. Any Fellow or Fellows making a discovery or invention germane to the subject of their investigation shall, at any time, at the option and expense of the Company, apply for letters patent, and shall upon demand assign such letters patent and any and all right to such invention to the Company under the conditions of this Agreement. In case the Company desires to keep secret such discovery or invention, or for any reason desires that letters patent shall not be applied for, the Fellow or Fellows shall not at any time apply for patent or patents in their own name, and shall not disclose such discovery or invention to others except as herein provided.

7. The Company shall, in addition to the sums paid to the Institute as foundation for the Fellowships, pay to the Fellows collectively a maximum cash bonus of ———————— dollars ( ) or any part thereof which in the opinion of the Board of Arbitration (hereinafter provided for) is deserved by the Fellows of this Fellowship, and the amount of this payment and the

time or times of payment shall be decided by the Board of Arbitration upon application of either of the parties hereto. The relative distribution of the bonus to the individual Fellows concerned shall be wholly within the power of the Director to decide and determine.

8. In the event of any difference of opinion between the parties hereto as to the interpretation of this Agreement, or the rights of the respective parties to this Agreement, the matters in issue shall be referred to a Board of Arbitration, which Board shall consist of a representative of the Institute and a representative of the Company, and a third person whom these two shall select. The decision of this Board shall be obtained without recourse to the courts and when rendered shall be binding upon the parties hereto.

9. During the term of this Fellowship, the holders thereof may publish such results of their investigations as do not, in the opinion of the Company, injure its interests. On or before ———— ————, 19—, the holders thereof shall complete a comprehensive monograph on the subject of their researches. The subject matter of such monograph shall not contain specific information of the process or methods of the Company but it shall be confined to a statement of new discoveries of scientific fact obtained by this Fellowship and such statement shall not contain data or information in regard to the cost of manufacture by any process revealed in such statement. A copy of this monograph shall be forwarded to the Company and a copy shall be signed and placed in the archives of the Institute until the expiration of three years from the time hereinafter provided for the termination of this Fellowship, when the Institute shall be at liberty to publish it for the use and benefit of the public.

In the event that in the opinion of the Company such publication at such time will unduly injure its interests, it shall have the privilege of appealing at any time for an extension of time of such publication to the Board of Arbitration provided for herein, which, after considering the appeal, shall, if in its opinion such publication will unduly injure the Company's interests, extend the time of publication to a time when in the Board's opinion publication will not unduly injure the interests of the Company.

10. The Fellowships provided under this Agreement shall terminate the ——— day of ————, 191—.

In witness whereof, the parties hereto have caused their names to be subscribed the day and year first above mentioned by their duly authorized officers.

Witness: Mellon Institute of University of Pittsburgh

———— By ————————

————————

———— By ————————

The permanent building which will be in occupation by the institute by next September is splendidly fitted to correspond with its needs. In order that the institute may not grow too large for maximum efficiency in its different researches and for the maintenance of its fraternal spirit it has been determined to limit its members to seventy fellows. As the present number of fellows is thirty-seven, this will necessitate a considerable increase in the directional and supervisional permanent staff. Perhaps I may be permitted to say here that I am eagerly on the watch tower for men possessed of the rare qualities requisite for such positions.

The Graduate School of Specific Industries which will be connected with the Institute on the completion of its building, I shall make the subject of a future statement.

Finally it may be said, on the basis of the two years intervening since my last statement to this journal, that this system of cooperation between industry and learning, between the factory and the university, has positively passed the tentative and experimental stage and that it now stands as a valuable and permanent relation to both. Any anxieties I may have are not now connected with this example of the system, but with my desire that it should be extended into other educational institutions. We believe that this can be accomplished by handing over to the universities for this service some of our own men inducted into a full knowledge of the working of this system through years of connection with it.

Robert Kennedy Duncan

THE NEW PERUVIAN EXPEDITION UNDER THE AUSPICES OF YALE UNIVERSITY AND THE NATIONAL GEOGRAPHIC SOCIETY

LAST Saturday there sailed for Peru the topographical division of a new expedition. The chief engineer, E. C. Erdis, of the 1912 expedition, had sailed the week before. In a short time two more members of the expedition will sail, and as soon as the maps have been completed and are ready for use, the scientific members of the party will leave for the field. This will probably not be until early in 1915.

As in 1912 the expedition is under the joint auspices of Yale University and the National Geographic Society. Unlike former expeditions, it will cover a period of two years, instead of being confined to one field season. Three members of the expedition, the chief engineer, the chief assistant, and the assistant topographer, will be in the field for a year and a half, or more.

It is our plan to make a geographical reconnaissance of a portion of southern Peru, including the Cordillera Vilcabamba and portion of the Apurimac and Urubamba watersheds.

This region is a part of the eastern edge of the great Andean plateau. The Cordillera Vilcabamba is a chain of dissected mountains rising 16,000 to 20,000 feet above sea-level, situated between south latitudes 12 and 14. Their bases are clothed with tropical jungles, while their summits are mantled with snow and glaciers. In the main they are unexplored. As one of the most inaccessible parts of the Andes, they have been occupied from time to time by the ancient peoples of Peru. In this region are the ruins of Machu Picchu, Palcay and Choqquequirau.

The reported presence of other ruins and the actual existence of some that have been seen, but not studied or mapped, make the region a particularly attractive area in which to study the problem of man's origin and distribution in South America.

The character of the land formations in the neighborhood of the ruins should enable something to be said in regard to the number of people formerly occupying the region, the causes of the location of the cities, buildings and forts, and the reasons for their final abandonment.

An examination of the ruins, studies of the styles of architecture, and of the artifacts and other remains that may be found fairly near the surface of the ground, should eventually enable a classification to be made, which, in connection with biological, physiographic, linguistic and historical studies, ought to result finally in unravelling the puzzle of the ancient civilization of South America. From the standpoint of biology, this area is believed to contain a large number of species new to science. From the standpoint of anthropology it is one of the least known and most fruitful areas in the Andes.

The plan of work will include the making of a topographical map of the region northwest of Cuzco between the Apurimac and Urubamba Rivers; a detailed geographical reconnaissance of the more lofty portions of the mountains, including a study of the large undescribed glaciated region; the establishment of two meteorological stations at different elevations for the taking of systematic records for two years; a study of the distribution and history of food plants of this region; the collection of data respecting the forms and distribution of vertebrates, particularly mammals and reptiles; a survey of the present Indians inhabiting this region, including a study of their dialects, the collection of anthropometric data, and the collection and study of the skeletal remains; an archeological reconnaissance of the entire area, and a continuation of the studies begun by the first expedition, looking toward a geographical interpretation of the Spanish chronicles of the era of discovery and exploration, with particular reference to the identification of ancient place names, the story of Machu Picchu and its connection with the history of the Incas.

The staff of the expedition consists of: Ellwood C. Erdis, chief engineer; Herbert E. Gregory, geologist (Silliman professor of geology in Yale University); George F. Eaton,

osteologist (curator of osteology in the Peabody Museum of Yale University); Albert H. Hardy, chief assistant; C. F. Westerberg, assistant topographer; H. S. Arnold, M.D., medical adviser; Philip A. Means, assistant in archeology; L. M. Kirkpatrick, secretary. The surgeon has not yet been named.

Hiram Bingham,
Director

THE COMMITTEE OF ONE HUNDRED ON SCIENTIFIC RESEARCH OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

This committee, authorized by the council of the association and appointed at and after the Atlanta meeting by President Wilson and President Eliot with the advice of the committee of policy, met at the Cosmos Club, Washington, on the afternoon of April 20, 1914. Mr. Pickering was in the chair, and the following members were present:

Messrs. C. L. Alsberg, E. W. Brown, J. McK. Cattell, C. B. Davenport, K. E. Guthe, George E. Hale, Ross G. Harrison, L. O. Howard, C. S. Howe, William H. Howell, W. J. Humphreys, William W. Keen, C. Kenneth Mees, George A. Miller, E. L. Nichols, Arthur A. Noyes, Henry F. Osborn, E. C. Pickering, Ira Remsen, Frank Schlesinger, Elihu Thomson, O. H. Tittmann, Thomas L. Watson, Arthur G. Webster, William M. Wheeler and R. S. Woodward.

The membership of the committee was completed by election, and there was a long and important discussion on scientific research in America and the means by which it can be advanced by the committee. Among the questions fully discussed were (1) the use of research funds and the establishment of a central bureau under the auspices of the association, the National Academy or the Smithsonian Institution; (2) research work in educational institutions, the extent to which it is supported and should be regarded as the function of the institution and its professors and instructors; (3) the research work of industrial laboratories and its relation to the universities; (4) the selection of men in universities competent to undertake research work and the preparation that should be given to them, and (5) the fuller recognition and better opportunities that should be given to those who have unusual qualifications for scientific research. It was agreed that the principal work of the committee should be entrusted to sub-committees. The whole committee will meet at Philadelphia on the afternoon of Monday, December 28, 1914, at the hotel headquarters of the American Association.

Sub-committees were authorized in each of the five directions above noted. The three last-mentioned topics were emphasized, respectively, by Mr. C. Kenneth Mees, Mr. Ernest W. Brown and Mr. Theodore W. Richards, and a sub-committee on each of the subjects will be formed with their advice. The committees named are:

Executive Committee: E. C. Pickering, *Chairman*, Charles D. Walcott, William H. Welch, Edmund B. Wilson, J. McKeen Cattell, *Secretary*.

Sub-committee on Research Funds: Charles S. Minot, *Chairman*, Simon Flexner, E. C. Pickering, R. S. Woodward, Charles R. Cross, *Secretary*.

Sub-committee on Research in Educational Institutions: Edward L. Nichols, *Chairman*, Edwin G. Conklin, Arthur A. Noyes, John M. Coulter, J. McKeen Cattell, *Secretary*.

The full membership of the Committee of One Hundred is as follows:

Eliot, Charles W., president of the association, president emeritus of Harvard University, *Chairman*.

Pickering, E. C., director of the Harvard College Observatory, *Chairman of the Executive Committee*.

Adams, Frank D., professor of geology, McGill University.

Alsberg, C. L., chief of the Bureau of Chemistry, U. S. Department of Agriculture.

Ames, J. S., professor of physics, Johns Hopkins University.

Angell, J. R., professor of psychology, University of Chicago.

Baldwin, S. E., professor of law in Yale University and governor of Connecticut.

Bancroft, W. D., professor of physical chemistry, Cornell University.

Bessey, Charles E., professor of botany, University of Nebraska.

Boas, Franz, professor of anthropology, Columbia University.
Britton, N. L., director of the New York Botanical Garden.
Brown, Ernest W., professor of mathematics, Yale University.
Campbell, Douglas H., professor of botany, Stanford University.
Campbell, W. W., director of Lick Observatory.
Chamberlin, T. C., professor of geology, University of Chicago.
Chittenden, R. H., professor of physiological chemistry, Yale University.
Cole, Alfred D., professor of physics, Ohio State University.
Conklin, Edwin G., professor of zoology, Princeton University.
Cottrell, F. G., professor of physical chemistry, University of California.
Coulter, John M., professor of botany, University of Chicago.
Councilman, W. T., professor of pathology, Harvard University.
Cross, Charles R., professor of physics, Massachusetts Institute of Technology.
Davenport, C. B., director of the Station for Experimental Evolution, Carnegie Institution.
Davis, William M., emeritus professor of geology, Harvard University.
Day, Arthur L., director of the Geophysical Laboratory, Carnegie Institution.
Dewey, John, professor of philosophy, Columbia University.
Donaldson, H. H., professor of neurology, Wistar Institute of Anatomy.
Fairchild, H. L., professor of geology, Rochester University.
Farlow, W. G., professor of cryptogamic botany, Harvard University.
Fisher, Irving, professor of economics, Yale University.
Flexner, Simon, director of the laboratories, Rockefeller Institute for Medical Research.
Franklin, Edward C., professor of organic chemistry, Stanford University.
Gill, Theodore, professor of zoology, George Washington University.
Goodale, George L., emeritus professor of botany, Harvard University.
Guthe, Karl E., professor of physics, University of Michigan.
Hale, George E., director of Mount Wilson Solar Observatory, Carnegie Institution.
Harrison, Ross G., professor of comparative anatomy, Yale University.
Hayford, John F., director of the College of Engineering, Northwestern University.
Holmes, Joseph A., chief of the Bureau of Mines.
Howard, L. O., chief of the Bureau of Entomology.
Howe, Charles S., president of the Case School of Applied Science.
Howell, William H., professor of physiology, The Johns Hopkins University.
Humphreys, W. J., professor of meteorology, U. S. Weather Bureau.
Hunt, Reid, professor of pharmacology, Harvard University.
Jordan, David Starr, president of Stanford University.
Keen, William W., emeritus professor of surgery, Jefferson Medical College, president of the American Philosophical Society.
Kemp, James F., professor of geology, Columbia University.
Leuschner, Armin O., professor of astronomy, University of California.
Lillie, Frank R., professor of embryology, University of Chicago.
Loeb, Jacques, head of department of experimental biology, Rockefeller Institute for Medical Research.
MacDougal, D. T., director of the department of botanical research, Carnegie Institution.
Maclaurin, R. C., president of the Massachusetts Institute of Technology.
McMurrich, J. Playfair, professor of anatomy, University of Toronto.
Mall, Franklin P., professor of anatomy, Johns Hopkins University.
Marvin, C. F., chief of the U. S. Weather Bureau.
Mees, C., Kenneth, Eastman Kodak Company, Rochester, N. Y.
Mendenhall, T. C., president emeritus, Worcester Polytechnic Institute.
Michelson, A. A., professor of physics, University of Chicago.
Miller, G. A., professor of mathematics, University of Illinois.
Millikan, R. A., professor of physics, University of Chicago.
Minot, Charles S., professor of comparative anatomy, Harvard Medical School.
Moore, E. H., professor of mathematics, University of Chicago.
Moore, George T., director of the Missouri Botanical Garden.

Morgan, T. H., professor of experimental zoology, Columbia University.
Morley, Edward W., emeritus professor of chemistry, Western Reserve University.
Morse, Edward S., director, Peabody Academy of Science.
Moulton, Forest R., professor of astronomy, University of Chicago.
Neal, Herbert V., professor of biology, Tufts College.
Nichols, Edward L., professor of physics, Cornell University.
Noyes, Arthur A., director of the research laboratory of physical chemistry, Massachusetts Institute of Technology.
Noyes, W. A., professor of chemistry, University of Illinois.
Osborn, Henry F., president of the American Museum of Natural History, research professor of zoology, Columbia University.
Pearce, R. M., professor of research medicine, University of Pennsylvania.
Putnam, E. W., professor emeritus of anthropology, Harvard University.
Remsen, Ira, professor of chemistry, Johns Hopkins University.
Richards, Theodore W., professor of chemistry, Harvard University.
Rosa, Edward B., chief physicist, Bureau of Standards.
Schlesinger, Frank, director of the Allegheny Observatory.
Sedgwick, William T., professor of biology, Massachusetts Institute of Technology.
Smith, E. F., provost of the University of Pennsylvania.
Smith, G. Otis, director of the U. S. Geological Survey.
Smith, Hugh M., U. S. commissioner of fisheries.
Smith, Theobald, professor of comparative pathology, Harvard University.
Stieglitz, Julius, professor of analytical chemistry, University of Chicago.
Stiles, Ch. Wardell, zoologist, U. S. Public Health Service.
Stratton, Samuel W., director of the Bureau of Standards.
Thomson, Elihu, Thomson-Houston and General Electric Companies.
Titchener, Edward B., professor of psychology, Cornell University.
Tittmann, Otto H., chief of the U. S. Coast and Geodetic Survey.
Van Hise, Charles R., president of the University of Wisconsin.
Walcott, Charles D., secretary of the Smithsonian Institution.
Ward, Henry B., professor of zoology, University of Illinois.
Watson, Thomas L., professor of economic geology, University of Virginia, and director of the Virginia Geological Survey.
Webster, Arthur G., professor of physics, Clark University.
Welch, William H., professor of pathology, Johns Hopkins University, president of the National Academy of Sciences.
Wheeler, William M., professor of economic entomology, Harvard University.
Whitney, Willis R., director of the research laboratory, General Electric Company.
Wilson, Edmund B., professor of zoology, Columbia University.
Woodward, Robert S., president of the Carnegie Institution of Washington.
Cattell, J. McKeen, professor of psychology, Columbia University, *Secretary*.

SCIENTIFIC NOTES AND NEWS

Dr. Woldemar Voigt, professor of theoretical physics at Göttingen, will next year be the visiting professor from Germany to Harvard University.

On the recommendation of the council and of the special committee on the Hayden Award the Academy of Natural Sciences of Philadelphia has this year conferred the memorial gold medal on Henry Fairfield Osborn in recognition of his distinguished work in vertebrate paleontology.

Dr. Simon Flexner, director of the laboratories of the Rockefeller Institute for Medical Research, has received notice through the French ambassador in Washington that the cross of chevalier of the legion of honor has been conferred upon him by the president of the French Republic. This honor has been bestowed in recognition of the services which Dr. Flexner has rendered to medical science through his own discoveries and through his administration of the Rockefeller Institute. Special mention is made in the award of the assistance given to France at the time of the epidemic of cerebro-spinal meningitis, which prevailed in 1909, by sending to the Pasteur

Institute in Paris a supply of anti-meningitis serum which was successfully used in combating that epidemic.

SURGEON-GENERAL WILLIAM C. GORGAS, U. S. Army, has been awarded the Dr. Louis Livingston Seaman medal by the American Museum of Safety as a recognition of his work in making the Panama Canal Zone habitable and sanitary.

DR. JOSIAH ROYCE, since 1885 professor of the history of philosophy at Harvard University, has been transferred to the Alford professorship of natural religion, moral philosophy and civil polity, vacant by the retirement of Professor Palmer.

DR. JULIUS VON HANN, professor of cosmical physics at Vienna, has celebrated his seventy-fifth birthday.

PROFESSOR C. S. SHERRINGTON, Waynflete professor of physiology in the University of Oxford, has been elected a member of the Royal Danish Academy of Sciences.

ZÜRICH UNIVERSITY has conferred the honorary degree of doctor of natural sciences upon Professor Alfred Werner, of Zürich, winner of the last Nobel Prize for chemistry.

DR. LAWRENCE MARTIN, associate professor of physiography and geography at the University of Wisconsin, has been elected a corresponding member of the Kaiserlich-königliche Geographische Gesellschaft in Vienna.

SECRETARY LANE, of the Department of the Interior, has appointed Professor R. H. Fernald, of the University of Pennsylvania, as consulting engineer to the Bureau of Mines. He will be sent to England, France, Belgium, Germany and Austria to investigate improvements with gas producers in the development of metallurgical and power operations.

DR. HANS MURSCHHAUSER, of the Akademische Kinder-Klinik in Düsseldorf, has been appointed research associate of the Carnegie Institution of Washington, attached to the nutrition laboratory at Boston.

DR. FREDERICK M. MEADER has resigned as city bacteriologist of Syracuse, and has been succeeded by Dr. Oliver W. H. Mitchell, assistant professor of bacteriology and preventive medicine in the University of Missouri. Dr. Mitchell also succeeds Dr. Leverett D. Bristol as assistant professor of bacteriology in Syracuse University.

MR. ALFRED E. CAMERON, board of agriculture scholar in entomology, Manchester, England, is spending the summer at the entomological department of the Agricultural Experiment Station, New Brunswick, N. J. He has recently arrived from England.

PROFESSOR FRANCIS E. LLOYD, of McGill University, will spend the period from May 1 to September 15, at the coastal laboratory of the Carnegie Institution of Washington, Carmel-by-the-Sea, Calif.

MR. STEWART CULIN, curator of the department of ethnology of the Brooklyn Museum, is at present in the far east in order to collect ethnological material. His itinerary has taken him to Japan, China, Korea, India and Ceylon.

THE Congo expedition of the American Museum of Natural History under Messrs. Herbert Lang and James Chapin, which in cooperation with the Belgian government has been carrying on active field work in central Africa for the past four years, will return to New York early in the summer.

DR. HERMANN VON SCHRENK, pathologist to the Missouri Botanical Garden, delivered a series of five lectures before the members of the department of forestry of the University of Toronto, in March, on "Diseases of Trees and Structural Timbers."

MRS. CHRISTINE LADD-FRANKLIN gave, on April 20, 21 and 22, three lectures at the University of Chicago as follows: "The Bridge between the New Logic and the Old," "The Indispensable Requirements of a Color Hypothesis," "Graphic Representation of Color Relations and Recent Views on Color."

THE second open meeting of the Society for Biological Research of the University of Pittsburgh for the year 1913–14 was held on April 16, at which time Dr. John F. Anderson, director of the hygienic laboratory of the U. S. Marine Hospital and Public Health Service, gave an

address on the "Etiology and Distribution of Typhus Fever."

Dr. Barton Warren Evermann, director of the Museum of the California Academy of Sciences, delivered the address at the annual meeting of the Beta Kappa Alpha Society of the University of California, at Berkeley, on the evening of April 16. His subject was "The Alaska Fur-seal Herd and its Proper Management."

The building of the College of the City of New York, hitherto known as the Mechanic Arts Building, will, by vote of the trustees, hereafter be called "Compton Hall," after Professor Alfred G. Compton, late head of the department, who died in the autumn of 1913.

The municipality of Saint-Georges-sur-Cher has decided to erect a monument to Bretonneau, of Tours, one of the distinguished names in the history of French medicine, who was born there in 1774.

Philippe Edouard Leon Van Tieghem, eminent French botanist, died in Paris on April 28 at the age of seventy-five years.

Dr. Karl Chun, professor of zoology at Leipzig, distinguished for his oceanographic studies, has died at the age of sixty-two years.

Dr. Paul Ehrenreich, the distinguished ethnologist, docent in the University of Berlin, has died at the age of fifty-eight years.

Professor Adolf Fischer, director of the Museum for Asiatic art, founded last October at Cologne, has died at the age of fifty-eight years.

The medical college of Cornell University and the General Memorial Hospital will establish a cancer hospital, towards which it is said $1,000,000 have been subscribed, including $500,000 from Dr. James Douglas.

The cornerstone has been laid for a building for a Servian Academy of Science in Belgrade, the cost of which is to be about a million dollars.

The Memorial Institute for Infectious Diseases, of Chicago, has moved into its new building at 629 South Wood St., to which address all communications should be sent. This is also the new address of *The Journal of Infectious Diseases.*

The late Mr. Henry Bloom Noble, of Douglas, Isle of Man, left practically all his estate for educational and charitable purposes in the island. The trustees of his will have decided to devote £20,000 for the fostering of agriculture.

Through the generosity of Mr. George Manierre, of Chicago, the mounted skeleton of the American mammoth which has for many years been exhibited in the museum of the Chicago Academy of Sciences, has been transferred to the Field Museum of Natural History. This skeleton long remained the only mounted skeleton of the mammoth in America and it still forms one of the best representatives of this animal known.

The American Museum of Natural History has acquired from the estate of the late Edwin E. Howell, of Washington, a well-known collector and dealer, the entire collection of meteorites which belonged to his establishment at the time of his death. The collection consists of representatives of fifty-four falls and finds, aggregating about one hundred kilometers in weight. It includes two which have not been heretofore represented in the museum, namely, the Ainsworth and Williamstown irons. This acquisition was made possible through the generosity of Mr. J. P. Morgan.

After a conference with the trustees of the University of Pennsylvania following the close of the trial of Professor J. E. Sweet for cruelty to animals and the disagreement of the jury, Dean William Pepper, of the department of medicine, announced that the continuation of the experimental work in the medical school was authorized. It was agreed by all that the university owes it to humanity to continue the work without interruption.

Last spring the attention of the Maine Agricultural Experiment Station was called to maggots infesting blueberries towards the end of the season. Accordingly larvæ were reared and the insect ascertained to be the same species which infests the apple, *Rhagoletis pomonella.*

APART from the governments and government departments which will be represented at the International Congress of Tropical Agriculture to be held at the Imperial Institute, London, from June 23 to 30, a number of societies, chambers of commerce and associations, foreign as well as British, have indicated their intention to support the congress, and most will send delegates. It is already known that the congress will be attended by members from the following countries: Austria, Egypt, France, Germany, Holland, Italy, Japan, Portugal, Russia, the United Kingdom, the United States, Ceylon, East Africa, Gold Coast, Honolulu, India, Jamaica, Java, Leeward Islands, Nigeria, Sierra Leone, Straits Settlements and Federated Malay States, Trinidad and Uganda.

IT is announced that arrangements are being made for the holding in Edinburgh, in September next, of a conference on the various aspects of the physical sciences in their application to the study of the phenomena of weather. Sir John Murray had consented to act as president, but now new arrangements must be made. It is planned to open the conference on September 8, and to continue its work during the four following days. Those interested should send their names to the secretary of the organizing committee at the Meteorological Office, South Kensington, London, S. W.

THE thirteenth general meeting of the Association of Economic Biologists was held at the Imperial College of Science and Technology, London, on April 10 and 11. Professor Robert Newstead presided. According to the report of the London *Times* Mr. A. G. L. Rogers, of the Board of Agriculture, communicated the results of the International Phytopathological Conference lately held in Rome with the object of considering how united action may be taken for checking the importation of plant diseases. There are two ways of dealing with a center of plant infection. The first is to forbid the entry of plants from the infected district or country. The alternative is for the administrative authorities in the infested country to take the necessary steps for extirpating the pest within their borders; and to issue a guarantee of freedom from infection with all lots of the suspected produce. This procedure is an impossibility in the case of the bulky crops of what in France is called "La Grande Culture," as no staff of specialists could deal with the amounts grown. The international delegates therefore unanimously agreed to exclude these (including all grains) and the grape vine from their provisions, the various nations being left to protect themselves from diseases of staple crops by individual action as at present. The recommendations, however, provide for including such produce as fruit, flowers and bulbs in the proposed convention, which at present awaits ratification, all the powers except the United States having provisionally agreed to the principle of united action. Certain powers, while not prepared to relinquish the right of inspecting imported produce included in the provisions of the convention, intimated their willingness to let these rights be in abeyance so long as exporting countries fulfilled their obligations.

IT is planned to take the biological work of the University of Utah Summer School to a mountain laboratory during the last three weeks of the course. Animal ecology and some systematic study of flowering plants will be the parts of the work best adapted to this plan. The regular session will begin on June 8 and close on July 17, the change of base for biology to be made on June 26. Silver Lake, at the head of Big Cottonwood Canyon, thirty miles from Salt Lake City, altitude 8,728 feet, has been chosen as the spot for beginning mountain station work in Utah. Here in a setting of rugged peaks lie a half dozen small gems of mountain lakes, one at an altitude of 9,920 feet, and a beautiful little mountain valley in which rise from innumerable sources the headwaters of Big Cottonwood Creek, a typical mountain stream. From the tops of these peaks to the warm and hot springs, the sulphurous and salt waters, the desert and the Great Salt Lake itself in the valley near the university, stretches a wide va-

riety of conditions to receive attention in ecology. Persons desiring further information may communicate with Dr. Charles T. Vorhies, University of Utah, Salt Lake City.

Mr. C. V. Hodgson, of the Coast and Geodetic Survey, Department of Commerce, has recently left Washington for the southwestern part of the United States, where he will have charge of a party for the determination of the astronomic latitude of triangulation stations established by the Coast and Geodetic Survey and the United States Geological Survey, between Barstow, Tex., and the Pacific Ocean. Many of these stations are on mountains as much as 10,000 feet in height. The results of this work will be used principally for geodetic purposes, that is, the determination of the figure of the earth and the distribution of material in the earth's crust. The means of transportation for this party will be a 1½-ton automobile truck which was used successfully on similar work between Denver, Col., and the Canadian border in the season of 1913. A similar truck had been employed also in 1912 on the 49th parallel boundary survey between the United States and Canada. The cost of the work during the season of 1913 is estimated as only one half what it would have been if horses and wagons had been used for transportation. The saving in the coming season is expected to be even greater, as the country to be traversed is arid or semiarid and the transportation of water and forage for stock would have been a difficult problem. It is expected that the work will continue until late in the autumn.

UNIVERSITY AND EDUCATIONAL NEWS

The new buildings of Zürich University were formally opened on April 19. The buildings, which cost about $1,700,000, stand on rising ground overlooking both lake and city.

Dr. Theodore C. Janeway, Bard professor of the practise of medicine in Columbia University, has accepted the professorship of medicine in Johns Hopkins University under the full time basis made possible by the gift of $1,500,000 by the General Education Board.

Dr. Mazyck P. Ravenel, professor of medical bacteriology in the University of Wisconsin, and director of the public health laboratory, has accepted the chair of preventive medicine in the University of Missouri.

The board of regents of the State University of Washington has appointed a committee of three to consider the selection of a president and has requested the faculty to choose a like committee, which it has done by secret ballot. This joint committee will report to the faculty and to the regents.

Dr. E. R. Clark, associate in anatomy at Johns Hopkins University, has accepted an appointment to the chair of anatomy in the University of Missouri.

Dr. Leverett D. Bristol has left Syracuse University to take charge of the North Dakota state laboratory.

At the College of the City of New York Professor William Fox has been made full professor of physics and head of the department and Professor Laurel has been promoted to be full professor of mathematics.

Dr. William Hallock Park, professor of bacteriology and hygiene in the New York University and Bellevue Hospital Medical College, has been elected dean of the college by the council of New York University to succeed the late Dr. Egbert le Fevre.

Dr. Albrecht Bethe, professor of physiology at Kiel, has accepted a call to Frankfort.

Professor Dr. H. Merkel, professor of pathological anatomy at Erlangen, has been called to Munich.

DISCUSSION AND CORRESPONDENCE

MULTIPLE FACTORS IN HEREDITY

In Science, April 10, 1914, Professor Ramaley refers appreciatingly to the work of Dr. MacDowell on size inheritance in rabbits, which was carried out in my laboratory, and concludes that this work essentially substantiates Davenport's conclusion that the apparent blend of human skin color in mulattos is due to two distinct Mendelizing factors possessed by the negro, but lacking in the white races.

Professor Ramaley's note might lead one to infer that since Dr. MacDowell's work was carried out under my supervision and since his paper has been published with my approval, therefore I (in common with Mendelians generally) share the views expressed concerning Mendelian factors in size inheritance, but this is not entirely true, and to avoid further possible misunderstanding I write this note. Dr. MacDowell's observations I believe to be accurate; they were made with great care and were checked in every possible way. I have kept in close touch with his work at every stage of its progress and have found it unimpeachable. Few investigators with whom I have been associated have shown such aptitude for exact and critical work as he displayed from the beginning. I endorse his observations fully.

But the facts observed are capable of different theoretical interpretations. In regard to these I have encouraged in Dr. MacDowell the fullest freedom of choice. He has adopted one for which much can be said, that of multiple Mendelian factors, which at times has appealed to me strongly, and the argument for which I have presented elsewhere ("Heredity," D. Appleton & Co., 1911) at some length. This theory has also been developed independently by Lang (1910), East (1910), Emerson (1910) and others. It accounts for the facts fully if certain basic assumptions are allowed, about which, however, I am growing more skeptical the more closely I examine them. Dr. MacDowell, in the passage quoted by Professor Ramaley, truthfully says of this theory, "It goes hand in hand with the mutation and pure-line doctrines of De Vries and Johannsen." But suppose one is not prepared to accept those doctrines, what then becomes of the multiple factor hypothesis? It is left without adequate basis. If the multiple factor hypothesis must stand or fall with the pure-line doctrine, I for one can not accept it, for the foundations of the pure-line doctrine appear to me very insecure.

What in brief are the facts regarding size inheritance which call for explanation? Fortunately, observers are quite in agreement concerning them.

1. Occasionally an unmistakable Mendelizing factor is concerned in size inheritance. One was discovered by Mendel himself (1866) and its existence has been repeatedly verified, namely, the differential factor between tall and dwarf races of garden-peas. Tall and dwarf conditions in other plants behave in a similar way, that is as Mendelian alternative conditions showing both dominance and segregation in crosses. Brachydactyly in man is a variation like dwarfness in plants, in which the growth habit is altered, the skeleton being abnormally short and compact throughout. This character is a Mendelian dominant (Farabee, 1905, Drinkwater, 1908). The shorter, more compact form of Dexter cattle, in contrast with the Kerry breed, is a Mendelian character (Jas. Wilson, 1909) probably similar in nature. Doubtless the same was true of the short-legged Ancon sheep mentioned by Darwin (1878, "Animals and Plants").

From the mere fact that a Mendelian factor may be involved in a size difference, it by no means follows that *all* size differences are due to Mendelian factors. Such Mendelizing factors affecting size as have just been enumerated are distinctly rare. They are not discoverable at all in the cases studied by MacDowell, which involve neither dominance nor segregation in a 1:2:1 ratio. Even in cases involving an unmistakable Mendelian factor, as the tall-dwarf cross in peas, it is not to be supposed that no other factors affect size. For are all dwarf peas of the *same* height, or are all tall peas of the same height? No, there are differences among each sort, differences which are heritable also, since one dwarf variety differs from another in its mean height.

2. Ordinary differences in size (such as do not involve a change in the growth habit) among animals or plants do not Mendelize in the ordinary acceptation of the term. When races are crossed which differ widely in size, the first filial (F_1) generation is intermediate between the parents and often not more variable than one of the parent races. But the

second filial (F_2) generation, though still intermediate, commonly shows increased variability, the range of which may even extend into or include the size range of one or both parent races. This *increased variability* of the F_2 generation is the only evidence of Mendelism in size crosses. In 1911 I was inclined to regard it as *sufficient* evidence, but in this I was clearly mistaken, as a moment's consideration will show. It would be sufficient only (1) if the size differences were due *wholly* to Mendelian factors, and (2) further these factors were invariable, that is quantitatively always the same. But neither of these assumptions can be regarded as established. On any hypothesis size differences must depend on many mutually independent factors or causes. This is the prime significance of a frequency-of-error variation curve, however produced. It would be rash to assume that all the factors concerned are *Mendelizing* factors, in the total absence of the two usual accompaniments and criteria of Mendelism, dominance and segregation in recognizable Mendelian ratios.

The question whether Mendelian factors are constant or inconstant has been discussed from different points of view by my colleague Dr. East and myself in the *American Naturalist* (1912), he maintaining their constancy on the ground that they are subjective merely, while I have thought it necessary to assume for them an objective existence in the germ-cell, and am unable to discover any evidence of their constancy from the behavior of germ-cells. It is, of course, possible, as Dr. East maintained, to formulate a description of all heredity in terms of (purely subjective) Mendelian units, provided more and more units are from time to time created (by imagination) as the objective facts show the organism changed. But such an extension of Mendelism fails to interest me, as I think it does many of my readers. What we want to get at, if possible, is the objective difference between one germ-cell and another, as evidenced by its effect upon the zygote, and it is the constancy or inconstancy of these objective differences that I am discussing. If these are quantitatively changeable from generation to generation, then change in the variability of the zygotes composing a generation might arise without factorial recombination.

By way of illustration let us consider the simplest conceivable case. Suppose two organisms to differ by a single genetic factor for size. Suppose one organism to be of size 4, the other of size 8. On crossing, if each transmits its own condition and dominance is lacking, an intermediate is formed, size 6. On the theory of gametic purity, the gametes formed by this heterozygote of intermediate size (6) should be 4 and 8, respectively, and the next generation of zygotes (F_2) should be as follows:

Classes of zygotes	4,	6,	8,
Expected frequencies	1,	2,	1.

Here we note that a large part of the F_2 generation is intermediate in character, as was F_1, but F_2 is more variable than F_1, falling into three classes instead of one. This is the regular Mendelian way of viewing size inheritance, gametic purity being assumed. But is the assumption necessary or justifiable? Suppose the assumed size factor were *modifiable* or partially blending, so that 4 and 8, after association in the F_1 zygote, emerged as 5 and 7, respectively, in the gametes. Then F_2 would be:

Classes of zygotes	5,	6,	7,
Expected frequencies	1,	2,	1.

In this case, as well as in the supposed case of pure gametes, we should observe an F_2 more variable than F_1, though the *extreme* conditions of the parent organisms crossed would not be attained in F_2 (as, in fact, they rarely are). But even the recurrence of such extreme conditions as those of the grandparents might be explained as due to occasional failure of the gametes associated together in F_1 to modify each other.

Now I do not advocate either of these explanations. I present the second merely to show that the first is not the only conceivable explanation, and that I was earlier wrong in supposing an *increase* of variability *prima facie* evidence of the occurrence of *more* than a single Mendelizing factor. It might equally

well be regarded as evidence of a *single* Mendelizing factor, quantitatively variable.

If we set out by assuming that a Mendelian factor is invariable, then we are forced to assume, whenever genetic variation is observed in an organism, that this is due to an *additional* Mendelian factor. This is the real basis of the multiple factor hypothesis as applied to size inheritance, though not, of course, the historical one. But to reason thus is merely to pile one assumption upon another, which is not to advance science, whatever it does for a system or a terminology; but with these we are less concerned than with knowing the exact truth and in stating it as clearly and concisely as possible.

What now of human skin color, is this or is it not Mendelian in inheritance? At present I consider this largely a question of terminology. The *facts* appear to be very similar to those observed for body-size in rabbits, and for other quantitative characters in animals and plants. F_1 is intermediate; F_2 is also intermediate, but more variable than F_1. If we call this Mendelism, we shall need to explain that it is not the Mendelism of Mendel himself, but original Mendelism *plus* (1) the assumption of gametic purity, *plus* (2) the assumption of factorial constancy, *plus* (3) the assumption of factorial multiplicity.

W. E. CASTLE

BUSSEY INSTITUTION,
FOREST HILLS, MASS.,
April 15, 1914

JAVEL WATER—A SIMPLIFIED AND CORRECTED SPELLING

IN his "Grand dictionnaire universel du XIXé Siécle" (Paris, 1873), Pierre Larousse tells us that there used to stand upon the banks of the Seine in the suburbs of Paris in what is now the "XVe arrondissement" a solitary mill, sheltered by trees, where bathers and fishermen used to rest and partake of refreshments. This mill was known as the "moulin de Javel" and the lexicographer elsewhere states that this word is a variant of *javeau*, which means an island of sand and mud, a sandbank, although in this instance it is no doubt a proper name. The word *javelle* (cf. English, provincial, gavel), signifying an unbound sheaf or a bundle of grain smaller than a sheaf, is of different origin.

Upon the site of the old mill the village of Javel was founded in 1777 by the Count of Artois, who established a chemical works. The first directors of the works, Messrs. Alban and Vallet, were the originators of Javel water, which they prepared in 1792 by passing a current of chlorine through a solution of 2.440 kilos of "sub-carbonate" of potassium in 17 kilos of water. Larousse also refers explicitly to the erroneous spelling *eau de javelle*, employed by some authors. Littré in his "Dictionnaire de la langue française" (Paris, 1873) employs this erroneous spelling.

Unfortunately, the dictionary of the French Academy (7th edition, Paris, 1878) sanctioned the spelling "Javelle" for both the name of the mill and the derived name of the bleaching liquor, adding error to error in describing the liquid as a solution of potassium *chloride* in water ("L'eau de javelle est du chlorure de potassium en dissolution dans l'eau").

With such authority behind it, it is not surprising that the *-elle* ending has come into very general use. Yet a number of the more careful French and English writers employ the correct form of the word. Among such are Girard in "La grande encyclopédie" (article "Chlorures décolorants"); Emile Bouant in his "Dictionnaire de chimie" (Paris, 1888); Moissan in his "Chimie minérale" (1904–6); Edmund Knecht in the Encyclopedia Britannica, eleventh edition (article "Bleaching"); and Sir Edward Thorpe in his "Dictionary of Applied Chemistry" (1912). In Germany and America, as far as I have observed, the erroneous spelling is universally adopted. And our dictionaries of the English language appear likewise to be unanimously wrong. Not even the New Standard Dictionary (1913), which gives the simplified spellings of the Carnegie board, makes the least reference to the shorter form of this word.

A certain amount of confusion is prevalent also regarding the signification of the term

"Javel water." Originally it meant the liquor prepared by action of chlorine on dilute potash solution. In so far as its bleaching effect is concerned such a liquor is essentially a solution of potassium hypochlorite. It was inevitable, however, that when, through the cheapening of sodium compounds, potassium hypochlorite was superseded by the sodium salt, the name popularly applied to the bleaching liquor should undergo a change in signification. The fact that sodium hypochlorite solution was already employed in pharmacy under the name of *Labarraque's liquor* could not affect this change. Pharmaceutical language is too esoteric and popular habit too persistent to render it possible for the pharmaceutical term to supplant the established usage of the textile trade. I take it, then, that we must expect the sodium hypochlorite-chloride mixture to continue to be known as "Javel water." Such confused statements, however, as the following—let us hope a slip of the pen—are not to be excused even in a writer whose subject is one relating to textile chemistry. It occurs at p. 234 of Pellew's "Dyes and Dyeing," an excellent popularizing exposition of the triumphs of synthetic chemistry in this fascinating field:

> The potash and soda compounds, known respectively as Labarraque's solution and Javelle water, are less active and powerful than bleaching powder, but have the same general properties.

It is to be hoped that Mr. Pellew's readers will not be misled by either his definitions or his spelling.

J. F. Snell

Macdonald College,
Quebec, Canada,
February 27, 1914

SCIENTIFIC BOOKS

Manual of Petrographic Methods. By Albert Johannsen, Ph.D., Assistant Professor of Petrology, the University of Chicago. New York, McGraw-Hill Book Co. 677 pages, 770 figures in text and as whole page plates. $6.00 net.

The methods of microscopic petrography, like other laboratory methods, have advanced steadily in number and in complication during the fifty years of their practise, keeping pace with the increasing number of workers, the aim at greater accuracy and the developments of the petrographic microscope and its accessories. The author states in the preface that "the desire of an increasing number of students for more complete information in regard to modern petrographic-microscopic methods than is to be found in any English work on the subject" has led to the preparation of this book, but the reviewer knows no more complete and up-to-date treatment of this special subject in *any* language, for in most cases such works combine the general and theoretical part with a description of the individual minerals, while in this work only the methods are dealt with, but with a thoroughness, especially regarding the applications of optical mineralogy, which is of great value to the advanced student and investigator. Beginning with a short introductory chapter on crystallography and a thorough treatment of stereographic projection (so necessary for some of the more recent microscopic methods), chapters follow on the transmission of light through crystals, with a very complete and practical treatment of such topics as lenses, the petrographic microscope and the innumerable accessories which are now available, while the following chapters, comprising 300 pages, or nearly half the book, give a very complete account of the practical methods of application of the principles and instruments previously described. A somewhat briefer but sufficient account of the determination of specific gravity, mechanical separation of rock minerals, microchemical reactions, preparation of thin sections, etc., fills the remaining pages. The book is clearly printed and compact, notwithstanding the extended text and many figures; it represents a vast amount of careful, discriminating and constructive work on the author's part, as, for instance, is shown by the bibliography at the end of each chapter, and should be invaluable in its special field.

John E. Wolff

Harvard University

Catalogue of the Lepidoptera Phalænæ in the British Museum. Vol. XIII. Noctuidæ (part). By SIR G. F. HAMPSON, Bart. London, 1913. Pp. xiv + 609.

In this volume the consideration of the Noctuidæ is continued, the subfamily Catocalinæ being concluded from Vol. XII., the Mominæ and Phytometrinæ (better known as Plusiinæ), being given in full. There are 70 genera and 679 species included, besides some unrecognized ones. Colored plates CCXII. to CCXXXIX. accompany the volume.

Some of our most familiar names disappear, not by necessity, but by the author's non-recognition of the names in Hübner's "Tentamen" and "Zuträge." *Euclidia* Hübn. (Tent.) is replaced by the totally unfamiliar *Gonospileia* Hübn. (Verz.); *Agnomonia* Hübn. by *Argyrostrotis* Hübn. (Verz.); *Plusia* Hübn. (Tent.) by *Phytometra* Haw., which changes the familiar sub-family Plusiinæ to Phytometrinæ. However, this is in part set off by the retention of *Phurys* Guenée, which should have been replaced by *Crochiphora* Hübn. (Zutr.). According to the rules of nomenclature it appears to us that Hampson is clearly wrong in discarding these names.

On page 188, my species *distilla* is made a synonym of *Safia amella* Guen., but it is, in fact, abundantly distinct.

On page 207, *Zale* Hübn. is used instead of *Phœocyma* Hübn., by page priority, although the late J. B. Smith used *Phœocyma* in the monographic treatment of the American species. We are in favor of Hampson's action, and mention it only because it was held at the National Museum at the time that Smith could use either name he chose.

On page 331 some corrections of previous volumes appear. Our familiar genus *Erebus* replaces *Nyctipao* (Vol. XII., p. 273), a purely Asiatic genus and is lost to us. Likewise *Melipotis* Hübn. replaces *Ercheia* Walk., an old world genus, and disappears from our lists.

Under the Mominæ, my genus *Zazunga*[1] should have been included, with two species *zetacelis* and *opinor*. It would fall in the table with *Elydnodes*, but the thorax is clothed with hair only. HARRISON G. DYAR

[1] *Proc. U. S. Nat. Mus.*, XXXVIII., 251, 1910.

Einführung in die Vererbungswissenschaft. By RICHARD GOLDSCHMIDT. Second edition. Leipzig, Wilhelm Engelmann. 1913. Pp. 546. Price 14 marks.

The second edition of this work has been somewhat enlarged and in part rewritten. The first alteration to challenge attention is the thorough rearrangement of certain parts of the book. The chapters on Mutation and on the Inheritance of Acquired Characters are related to one another, and both are deferred to near the end of the book, after the sections on hybridization and sex determination. In the first edition those chapters are in the early part of the book, immediately after the discussion of variation. Graft hybrids and chimeras, instead of following hard upon Mendelian hybrids, are not discussed until after sex determination. Other chapters of the old edition are divided and the parts recombined. For example, the cellular basis of heredity is taken up in connection with sex determination, instead of independently; while minor sections are freely shifted under new captions. These changes appear to the reviewer to be in the interest of logical presentation.

The most extensive addition to the book is in the treatment of sex determination, sex inheritance, etc. These chapters are enlarged to the extent of about 35 pages. The striking feature of this enlargement is a proposed new formula for sex inheritance. Each sex is represented as containing factors for both sexes; one sex is homozygous for both these factors, the other is heterozygous for one of them and homozygous for the other. The factors are then weighted, in a manner not unlike that proposed by Spillman,[1] so that in one case femaleness, in the other maleness, come to expression. This formulation thus maintains the form of Mendelian inheritance, but contains elements of the quantitative theory of sex determination. The formula

[1] Spillman, W. J., *Amer. Nat.*, Vol. 44, 1910, pp. 214–228.

applies as well to species in which the female is the heterozygous sex as to those in which the male is heterozygous. The author does not hesitate to locate these factors in the chromosomes (though only one of them is in the X-chromosomes), and he is at considerable pains to show how this representation may be in harmony with the facts regarding several well-known cases of sex-limited inheritance. Crossing over (Morgan) is a modification of the regular process, but in no wise a contradiction.

Chapter XIII. is largely new. It relates to polymery, interference of genetic factors, sterility of hybrids and coupling of factors. Breeders, especially in Germany, come in for some sharp criticism for not adopting Mendelian methods and terminology. Inheritance in man is discussed in the final chapter of the book, which is new, and an extensive list of literature appearing from 1911 to 1913 is added to the old bibliography.

Numerous other changes, both additions and emendations, are made elsewhere. Many of these are made for pedagogical reasons. Some are of interest as indicating possible changes of the author's opinion. Thus, the author is now more inclined than formerly to regard the mutability of *Œnothera lamarckiana* as due to the hybridity of that species. He now leans more to the "Presence and Absence" theory of Bateson as representing the real truth. The chapter on inheritance of acquired characters is clarified, but the author's views are apparently little changed.

In a growing subject a book can scarcely be without errors. Thus, the four armadillo embryos of a litter are still referred to the first four blastomeres of the egg, whereas the reasons for so regarding them seem to have disappeared in the work of Patterson.[2] Typographical errors are few. Unfortunately, several of these have crept into the illustrations, but attention is directed to them in the legend.

The book is so good, however, that one can overlook its few faults. The new edition is plainly an improvement over the old. One could wish it were to be translated into English for the benefit of the American students who will not read it in the original.

A. Franklin Shull

[2] Patterson, J. T., *Jour. Morph.*, Vol. 24, No. 4, 1913, pp. 559–662.

Solvents, Oils, Gums, Waxes and Allied Substances. By Frederic S. Hyde, S.B. Consulting Chemist, New York. New York, Van Nostrand. 1913. Price $2.00.

These notes are for the use of factory chemists who wish a book on the subjects named which shall be condensed and authoritative.

The title suggests one of the good features of the book, that which gives the solvents for many of the substances mentioned; besides this, however, methods are given for the analysis of these compounds. In attempting to cover such a wide field it is not surprising that inaccuracies have crept in. For example, the statement regarding the Maumené-Sherman test (with sulphuric acid) is in error, as no dilution of the oil is necessary when using the ninety per cent. acid. The general unreliability of the Valenta test is not clearly stated. It is to be regretted that the "saponification equivalent" is again revived as it is infrequently met with at present. It should be noted that the New York State Tester is not commonly used for the ordinary lubricating oil—the Cleveland Cup is the one commonly employed. In the analysis of paints no reference is made to the use of the convenient centrifuge.

The book is one which will be very useful to all having to do with these substances.

A. H. Gill

SPECIAL ARTICLES

ADAPTATION OF THE TAMARISK FOR DRY LANDS

Although a specialist in the line of cereal investigations, the writer has had occasion during the past ten years, in connection with grain experiments in dry-farming in the Great Plains and Western States, to observe the comparative adaptation to conditions of drought of various orchard and forest trees. While certain trees, such as the black and honey locusts, the elm, Osage orange, hack-

berry and Russian mulberry, are generally known to be adapted for dry-land farming, it is surprising to find that so little attention has been given to the tamarisk as a shrub, or small tree, suitable for hedges and shelter belts, though the experience of the writer has shown it to be absolutely unequaled for this purpose. Only four experiment stations at present come to mind where the tamarisk is grown at all, and, even in these places as a rule, only for ornament or as a curiosity. These are the New Mexico Experiment Station, the Hays Branch Experiment Station, in Kansas, the Arizona Experiment Station at Tucson, and the Fallon Experimental Farm on the Truckee-Carson Irrigation Project in Nevada. At the last named place, however, it is being employed experimentally and from a practical standpoint because of its qualities above mentioned.

It is peculiar that the tamarisk is listed by a number of nursery companies as an ornamental for the humid areas of eastern United States and is commonly employed in that way. Rarely is any mention made in nursery catalogues of its adaptability for dry-land conditions. The writer was made acquainted with its drought-resistant qualities accidentally through having obtained a single specimen for planting in a yard in the southwestern plains. It was soon found to be by far the most drought-resistant and otherwise hardy of all the trees and shrubs planted on the same land, including about twenty species. There appears to be no limit in dryness of the soil on any usual Great Plains' farm beyond which this plant will not survive. It is also best fitted for saline soils of all plants yet known to the writer. It has an extremely rapid growth, and, by branching out close to the ground, produces an excellent close hedge which will soon turn some kinds of stock even with its absence of thorns. None of the species known to the writer grow very tall, not ordinarily more than twenty feet, though two rather old specimens have been observed near the courthouse at Tascosa, Texas, 12 to 15 inches in diameter.

To the ordinary observer, not a specialist in botany, the plant is best described by saying that it most resembles asparagus. It has a tendency to make a very scraggy growth and will not grow erect with the lower limbs very far from the ground unless carefully and constantly pruned to that end. Botanically it belongs to the order Tamariscineæ. It bears very small scale-like leaves and small pink or white flowers, which are either four or five parted.

On the land above mentioned, situated in the western portion of the Texas Panhandle, the writer has tried the method (also suggested by the editor of *The Oklahoma Farm Journal*) of dividing cultivated ground into narrow fields several times as long as broad, extending with their greatest dimensions east and west, and planting narrow belts of trees on the south sides of these fields to check the blowing of the soil, which method, so far, is found to be excellent. The trees employed in planting these belts were usually black locust, honey locust, Osage orange and Russian mulberry, but it is now the practise to plant tamarisk as the first row on the south side of each of these belts.

An interesting thing about tamarisk, and of the greatest importance where these trees are adapted and where nursery stock is not easily obtained, is the fact that the plant can be readily and rapidly propagated by means of cuttings. After two or three years' growth, therefore, of from one to one dozen specimens there need be no further purchase of stock, as there is then plenty of material in the way of cuttings from these trees for all ordinary planting purposes. If advantage is taken of an opportunity to put the cuttings in the ground just after a rain, no further attention is needed other than good cultivation, and during an average season on the driest farms in the Great Plains the trees will thereafter succeed without any question.

In the Kew Index there are listed about seventy species of tamarisk which are found in various parts of the world, but none are native in North America and, apparently, only a half dozen at most are found in Europe. Alfred Rehder has given a good account of the genus

in Bailey's "Cyclopedia of Horticulture." The plant seems particularly at home in northern Africa and in the immense semi-arid and desert region comprising the Aralo-Caspian district, Russian Turkestan, Arabia, Persia, etc. The following eleven species are listed by nurserymen in this country, but the accuracy of the names is not yet determined: *Tamarix Parviflora, T. Algerica, T. Amurensis, T. Odessana, T. Chinensis, T. Gallica* and variety *Indica, T. hispida* (= *T. Kashgarica*), *T. juniperina* (= *T. Japonica* and *T. plumosa*), *T. tetrandra* and *T. Germanica. T. Germanica* and eight or nine others are now, however, referred to *Myricaria.*

The most common species in cultivation in this country appear to be *T. parviflora* and *T. gallica,* the latter originating in southern France. Discussions on the tamarisk have commonly referred to it as being of African origin. For our Great Plains and the drier portions of the western states most likely the species of Siberian origin would be best adapted. Numerous specimens have been introduced into this country by the U. S. Department of Agriculture, chiefly from China and Chinese Turkestan.

It is very important not to confuse the tamarisk with the tamarack, an extremely different plant, adapted in fact to marshes.

These few notes on the above subject are offered with the hope that interest will be stimulated in much more extensive plantings of this remarkable drought-resistant and alkali-resistant shrub in the districts in this country where it is adapted.

Mark Alfred Carleton
U. S. Department of Agriculture,
Washington, D. C.

FINANCIAL STATEMENT OF THE PERMANENT SECRETARY OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

L. O. Howard, Permanent Secretary, in account with the American Association for the Advancement of Science. From November 1, 1912, to October 31, 1913.

Dr.

To balance from last account:		$7,836.40
Admission fees	$2,760.00	
Annual dues, 1913	20,891.75	
ditto 1914	119.00	
ditto previous yrs.	302.00	
Associate fees	15.00	
Life membership fees.	800.00	
Publications	57.25	
Bindings	5.00	
Jane M. Smith Fund...	5,000.00	
Interest	78.69	
Unclassified receipts, including postage and Treasurer's payment on Science subscriptions for Life Members	615.53	30,644.22
		$38,480.62

Cr.

By publications:		
Publishers Science....$14,796.45		
Proceedings, Vol. 62.. 1,901.09		$16,697.54
By expenses Cleveland meeting:		
Secretaries' expenses and commutations ..	540.09	
Badges, assistance and general expenses	115.71	655.80
By office expenses, including propaganda work:		
Postage	1,623.51	
Stationery, circulars and misc. printing	789.10	
Extra clerical help	653.85	
Engraving and printing certificates	105.00	
Telegrams, telephone, expressage, office supplies, etc.	463.25	3,634.71
By salaries:		
Permanent Secretary ..	1,500.00	
Assistant Secretary ...	1,500.00	3,000.00
By miscellaneous disbursements:		
To Treasurer (Jane M. Smith Fund)	5,000.00	
To Treasurer (life membership fees)	1,400.00	
To dues returned	13.00	6,413.00
By balance to new account..		8,079.57
		$38,480.62

The foregoing account has been examined and found correct, the expenditures being supported by proper vouchers. The balance of $8,079.57 is with the following Washington, D. C., banks:

American Security & Trust Co.....	$3,994.11
American National Bank of Washington	4,085.46
	$8,079.57

(Sgd.) Theo. N. Gill,
Auditor

Smithsonian Institution,
Washington, D. C.

SOCIETIES AND ACADEMIES

BOTANICAL SOCIETY OF WASHINGTON

THE ninety-third regular meeting of the Botanical Society of Washington was held in the Assembly Hall of the Cosmos Club at 8 P.M., Tuesday, January 6, 1914, with 42 members and 5 guests present.

Application for membership of Messrs. H. Pittier, Arno Viehoever and Raymond B. Wilcox were read. Messrs. Charles Thom, Charles S. Ridgway, George D. Clark, Clarence W. Carpenter, William A. Dayton, Orlo A. Pratt and Nathan R. Smith were elected to membership.

Mr. F. L. Lewton called attention to the discovery of the records of the Washington Botanical Club, the predecessor of this society from 1898–1902. He stated that these records were missing when the history of the society was written up a few years ago, and also gave a brief review of the club.

The scientific program was as follows:

The James River Hybrid Walnut: PETER BISSET. (With lantern.)

Lantern slides were shown of a walnut tree on the Rowe Farm, on the James River, opposite Lower Brandon, Va. The tree is 100 ft. high, with a spread of 123 ft., although until a recent storm the spread was 134 ft. At 4 ft. from the ground the tree is 31 ft. 3 in. in circumference, and at 6 ft. from the ground is over 25 ft. in circumference. At 12 ft. from the ground it divides into four large branches, three of which are larger than any tree in the neighborhood. No one has any definite knowledge of the age of the tree, but as the old farmhouse was built about 200 years ago it is supposed that the seed was planted at that time. Its growth was probably rapid, judged from seedlings which attained a height of 5 ft. 10 in. in one season, as compared with 3 ft. in seedlings of *Juglans nigra* which grew beside them. A seedling planted nearby about 1860 is now 2½ ft. in diameter and of the height of the parent tree. The characters of the leaves and nuts are such as to suggest a possible hybrid origin. The pubescence of the branches and leaves agrees with *Juglans cinerea* and the fruit and other leaf characters suggest *Juglans regia* instead of *J. nigra.* The nuts are of low vitality and very thick shell.

Smelter Injury in Southeastern Tennessee: DR. G. G. HEDGECOCK. (With lantern.)

To be published in the *Journal of the Washington Academy.*

Some Chinese Horticultural Brassica Species: DR. D. N. SHOEMAKER. (With lantern.)

Horticultural forms of Chinese Brassicas in the United States at present are: Three well marked varieties of mustard, *Brassica juncea.* These are well established in the American seed trade. Four types of non-pungent brassicas, of uncertain specific relations: (1) The heading forms, Chinese name *Pai Taai.* These make long heads resting on the surface of the ground, and present many varieties. (2) A form with long broad petioles, and long light green leaf blades, the veins of which are quite prominent. (3) A form with very broad short flat petioles, and dark green leaf blades. These usually send up swollen seeding stems. (4) A very loose-leafed round petioled form, used by the Chinese as a summer vegetable.

THE ninety-fifth regular meeting of the society was held at the Play House on Tuesday evening, March 3, 1914, at eight o'clock, at which the retiring president, Dr. W. W. Stockberger, delivered an address on the social obligations of the botanist (to be published in SCIENCE).

The ninety-sixth regular meeting of the society was held at the Cosmos Club, Tuesday, April 7, 1914, at eight o'clock.

Messrs. Robert B. Whitney and H. S. Westover were unanimously elected to membership in this society.

The scientific program was as follows:

Professor A. S. Hitchcock reviewed (*a*) a paper by Trabut in which he states that the oats commonly cultivated in temperate regions descended from *Avena fatua,* the Algerian oat from *A. sterilis* and *A. strigosa* from *A. barbata;* (*b*) a paper by Schulz on the origin of wheat in which he states that *Triticum monococcum* descended from *T. ægilopoides, T. dicoccum* from *T. dicoccoides,* and *T. spelta* from an as yet undiscovered wild form; that the naked wheats are derived from the spelt wheats, *T. turgidum, T. durum* and *T. polonicum* from *T. dicoccum,* and *T. vulgare* and *T. compactum* from *T. spelta.*

Dr. H. L. Shantz reviewed a paper by Sir Francis Darwin.[1] A method by which the influence of stomatal adjustment on the rate of transpiration is eliminated. The stomata of the lower surface of the leaf are locked with cocoa butter or petrolatum and incisions made through the upper epider-

[1] *Proceedings of the Royal Society,* Series B, Vol. 87, February, 1914.

mis, thus connecting the intercellular spaces with the outer air. By this method transpiration was found to decrease proportionally as relative humidity increased. The straight line relation led to the conclusion that a relative humidity of 105 would be required to reduce transpiration to zero.

C. S. Scofield, "Chinese Wild Rice," with lantern (to be published later).

Dr. P. Spalding, "Present Status of the White Pine Blister Rust," with lantern (to be published as a bulletin of the Department of Agriculture).

R. Zon, "Meteorological Observations for Purposes of Botanical Geography, Agriculture and Forestry," with lantern.

The inadequacy of the present climatic data for the purposes of botanists lies not so much in the kind and character of observations that are being recorded as in the manner of their classification, their grouping and computing.

To properly understand plant life, it is essential to group meteorological data by actual periods of growth and rest. During each of these two periods plants react to temperature of the air in an altogether different way. The temperature records of the temperate region of the United States should be computed separately on the basis of the normal monthly mean not reduced to sea level for the period of rest or the period of growth, and in some localities also for a third period, the hot period. The period of rest should include all months having a normal mean temperature of 48° F. or less. The period of growth should be included, all months having a normal monthly temperature of from 50° to 72° F. The hot period in temperature latitudes should embrace months with a normal average temperature of more than 72° F.

A map showing localities with the same duration of the periods of growth and rest has been tentatively prepared.

Aside from monthly mean temperatures the average temperatures by periods of ten days (decades) are also desirable, and also the mean temperatures for periods when the ground is covered with snow and periods when the ground is bare. Similarly, the mean temperature for each period during which certain winds prevail.

Summation of temperatures, as suggested by Bussengo and de Candolle, do not indicate the actual requirements of plants for heat, since they overlook the existence of an optimum temperature for the development of each plant.

Groups of days with a given temperature are considered preferable, and the following classification is suggested:

1. *Freezing days,* with a daily average of 32° or less. These are further subdivided into: (*a*) Freezing days without thawing; (*b*) freezing days with thawing.

2. *Cold days,* with an average daily temperature ranging from 32° to 40° F. This group should be further divided into: (*a*) Days with frost; (*b*) days without frost.

3. *Cool days,* with an average daily temperature from 40.1 to 50° F. This group should be divided into: (*a*) Days with frost; (*b*) days without frost.

The paper discussed also the temperature of the soil, humidity of the air, precipitation, snow cover, soil moisture, sunshine and barometric pressure.

P. L. Ricker,
Corresponding Secretary

The St. Louis Academy of Science

"Mounds and Mound Builders" was the subject of a lecture by Dr. H. M. Whelpley, at the February 16 meeting. It was illustrated with lantern slides.

The lecture dealt particularly with the mounds of Illinois and Missouri. Strictly speaking, there was no race of mound builders, mounds having been built by primitive peoples, the world over. Indian mounds were discussed and their various types explained. The important Cahokia Group, in Madison Co., Ill., was considered in detail. The general arrangement and location of these mounds was clearly shown in a series of maps of the Long Lake, Bluff, Forest Park, St. Louis, Cahokia and other subgroups. It was shown that at the time these mounds were built, the Mississippi River probably was close to the Illinois bluffs, so that they were all originally on the west side of the stream, a fact which helps to explain their similarity. From their nature, it is evident that many years must have been required for construction and the archeological evidence points to their having been built by an agricultural people, quite different from the Cahokia Indians whom white men found here. Some views as to their possible use were considered. The plan of Monks', or better, Cahokia Mound was discussed and a number of early drawings and diagrams were thrown upon the screen. The known history of this mound was reviewed. Attention was called to the artistic possibilities of mounds and the agencies tending toward their destruction were emphasized. The speaker closed with a plea for the preservation of these wonderful relics of earlier ages.

G. O. James,
Secretary